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The Analysis of Stock Returns in The London Stock Exchange in the Context of the Cyclical Adjusted Price to Earnings Ratio Signals

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PhD **2022**

The Analysis of Stock Returns in The London Stock Exchange in the Context of the Cyclical Adjusted Price to Earnings Ratio Signals

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A thesis submitted in partial fulfilment of the Robert Gordon University requirements for the degree of Doctor of Philosophy

April 2022

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Abstract

This thesis aimed to analyse the signalling capability of the Cyclically Adjusted Price to Earnings (CAPE) ratio and to analyse the performance of asset pricing models in the context of different market sentiments, as highlighted by the CAPE ratio. The behaviour of stock returns in the light of different asset pricing models is evaluated and compared in different subsamples classified as under priced, fairly priced and overpriced markets. The two main models used in this analysis are the Capital Asset Pricing Model (CAPM) and the Fama and French (1993) three factors model. This framework was also used to evaluate the Efficient Market Hypothesis that postulates that markets are efficient all the time.

To achieve the study's aim, the CAPE ratio was applied to the FTSE100 stock market index for the period from December 1998 to December 2017. The CAPE ratio identified the periods where the market was overpriced, fairly priced and under priced. Next, an active investment strategy based on the CAPE ratio signals was tested on the full sample and compared to a passive investment strategy to examine the effectiveness of using the CAPE ratio as a signalling tool for different trading strategies. The next step was to identify the different phases of the market that can be classified as overpriced, fairly priced and under priced markets, as per the signals of the CAPE ratio. The asset pricing models were employed on stock portfolios and their performance was examined in each one of the three market phases and on the full dataset.

The results of this study showed that the trading strategies based on the signals from the CAPE ratio are not likely to produce abnormal returns when compared to a buy and hold trading strategy in the long run. The CAPM test results showed that the subsequent returns were not fully in line with the predictions of the model in longer time periods as compared to shorter time periods, especially when the market was classified as fairly priced by the CAPE ratio. However, the pattern of the portfolios returns in different subsamples was not consistent. Thus, the CAPE ratio does not appear to be a suitable signalling tool in explaining the stocks returns behaviour in the light of the CAPM. The analysis of the Fama and French three factors model tests show that the model was suitable in explaining returns in most cases in the three subsamples and the full sample. The CAPE ratio seemed to have provided a good signal about subsequent returns if stock returns are analysed in the light of multi-factors like the size factor and value factor. However, it was not possible to beat the market based on the CAPE ratio signals. The performance of stock returns was not consistent as predicted by the CAPE ratio hence it was hard to classify any particular trading strategy based on the CAPE ratio's valuation signals. Thus, the Efficient Market Hypothesis stands strong in its conclusion that the markets are efficient and there are no easy arbitrage opportunities that investors can consistently exploit by employing certain ratios like the CAPE ratio to get signals about the future direction of the market.

Keywords: market efficiency, CAPE ratio, asset pricing models, CAPM, stock markets, London Stock Exchange, stock returns, Fama and French three factors model.

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Chapter 1 - Introduction

1.1 Study Background

Efficient Market Hypothesis postulates that in an efficient financial market, asset prices fluctuate randomly as they reflect the arrival of fundamental information related to that asset. This is due to the fact that the arrival of new information (good/normal/bad) into financial markets is random (Fama 1970, 1991). The analysis of the change in security prices in equity market makes information efficiency analysis a major area of research in finance. Several strong assumptions underlie the Efficient Market Hypothesis, including investor rationality and risk aversion, markets are perfect without frictions, and easy access to information by all market participants. Despite the great debate over the validity of these assumptions, financial economic researchers tend to accept them because their predictions seem to represent the reality adequately (Szyszka, 2013). Although standard finance theories are challenged by the reporting of puzzles, researchers are reconsidering the validity of these assumptions, resulting in theories that are based on the observation that investors may not act rationally all the time and that the market itself is also irrational as a result of limits to arbitrage (Barberis and Thaler, 2003).

The Efficient Market Hypothesis and the mainstream financial asset pricing models underlying assumptions led to generally distinctive implications for asset pricing, and particularly for the relationship between return and risk (Shefrin and Belotti, 2008). Despite the fact that sentiments play an important function in asset pricing, Statman et al. (2008) assert that conventional asset pricing relies only on utilitarian factors that solely represent risk. Even though the Efficient Market Hypothesis and asset pricing models' assumptions seem unrealistic, it does not imply that conventional asset pricing models are unreliable. As Lucas (1980) points out, a reliable model is not necessarily more realistic. Instead, a reliable model would rather explain reality more accurately.

The presence of anomalies like the development of asset pricing bubbles challenges the foundations of the Efficient Market Hypothesis that markets are efficient at all the times (Shiller 1981). It is important to analyse the behaviour of stocks returns during different business cycles. Many scholars attempt to explain the abnormal changes in stock price movements (Mollah 2007; Mittal and Jain 2009). Excessive levels of stock price volatility cast doubt on the Efficient Market Hypothesis (Shiller 2003). It is observed that changes in equity prices may not be related to changes in corporate performance all the time but are influenced by the sentiments in stock markets. For example, before the financial crisis due to the collapse of technology companies in 2001, where prices fell rapidly, the stock prices of firms did not reflect the fundamentals like sales growth rates and profit margins.

Professor Eugene Fama and Professor Richard Thaler sparked a debate on market efficiency and asset pricing bubbles, in which Professor Fama rejected the existence of bubbles as long as there is not an established mechanism to systematically identify it (Chicago Booth Review 2016). Instead, Professor Thaler's thesis revolves around the argument that bubbles do occur when the rational valuation of securities is outstripped by the rising stock prices (Chicago Booth Review 2016).

Many scholars have contributed to this debate through various publications like Camerer (2002), Shiller (2003), Greenwood, Shleifer and You (2019), and Weitzel et al.(2020). Moreover, the seminal work of Professor Robert Shiller (Shiller 1981, 2015; Campbell and Shiller 1988) led to the Cyclically Adjusted Priced to Earnings (CAPE) ratio which could be used to classify the market as under priced, fairly priced, and overpriced. If the CAPE ratio or any such tool is instrumental in classifying the market into these distinct phases, it will be interesting to analyse the stock return behaviour before and during these different phases and market levels.

One of the main objectives of this study is to analyse the signalling capabilities of the CAPE ratio and more importantly, if this could be used as an input in the trading strategies to make abnormal returns which could lead to challenge the significance of market efficiency. This study will also analyse the performance of most commonly used asset pricing models in the different market phases as identified by the CAPE ratio. The asset pricing models analysis will include the Capital Asset Pricing Model (CAPM) also known as a single factor model. CAPM is widely used in academia and is considered as one of the important asset pricing models (Dybvig and Ross 2003). Another model commonly used in academic studies is Fama and French Three Factors Model, which is known as a multi-factor asset pricing model (Fama and French 1993). Both models have proven effective in many research studies in different markets around the world like Pham et al. (2012), Bozec et al. (2014), Jin et al. (2015) and Khan (2016). The analysis of the performance of these models to different market phases like overpriced, fairly priced and under priced may provide important information that could be used to improve the efficiency of trading strategies used by investors and analysts in the stock markets. Furthermore, it can guide investors on an investment strategy suited to their level of risk preference.

For such a study to be effectively undertaken, it needs to be tested in a stock market that has good liquidity and depth and has companies from a variety of sectors. The London Stock Exchange is regarded as one of the world's leading equity markets widely known for its attractiveness to investors and companies in need of funding. Furthermore, it is a market that fits well into these categories and market sentiments needed in our study objective.

1.2 Problem Statement

Stock market investors, practitioners, regulators and academics constantly monitor the behaviour of stock returns and more importantly if the underlying market is efficient or not. There has been extensive scholarly research earlier in the 20th century, like those by Bachelier (1900), Graham, Dodd and Cottle (1934), Kendall (1953), Roberts (1959), Cootner (1964), Samuelson (1965), Jensen (1967), Fama (1970), Rubinstein (1975), Marsh (1979), Taylor (1988) and Brock et al. (1992), that contributed greatly to explaining the stock markets behaviour to facilitate better investment decisions. Likewise, recently published studies like Laopodis (2004), Ferson et al. (2005), Balsara et al. (2007), Lim et al. (2008), Skogsvik (2008), Bettman et al. (2009), Hatemi-J (2009), Borges (2010), Alexeev and Tapon (2011), Milian (2015), and Cengiz et al (2017) contributed to improving the existing body of knowledge and explained some of the anomalies that are not easily explained in the light of financial theory.

In spite of the strong views of Borges (2010) that accepting the Efficient Market Hypothesis in determining stock markets behaviour has an important ramification for investment strategies and financial theories; numerous studies conducted on economic and financial theories in general and Efficient Market Hypothesis in particular have failed to reach general agreement. Since the Great Depression of the 1930s, many financial crises have taken place in the global economy and that cannot be easily explained in the light of the Efficient Market Hypothesis. Furthermore, the work of Campbell and Shiller (1988, 2001, 2005) showed that they were able to predict both recent market corrections linked to the Dot Com bubble and the subprime mortgage crisis. This could be taken as a challenge to the EMH indicating that markets may not be efficient all the time. It is evident that more research is needed by the research community to figure out a more accurate and reliable solution to the stock market's valuation puzzle.

This study aims to contribute to knowledge by providing a comprehensive framework whereby the signalling capability of the CAPE ratio could be tested especially in terms of its usefulness in trading strategies. Moreover, it will also analyse the performance of the commonly used asset pricing models in the time periods or market phases that are classified by the CAPE ratio as under priced or overpriced.

1.3 Research Justification

Most studies conducted on the CAPE ratio were performed on the S&P 500, such as Tower (2012), Angelini et al (2018), Tolani et al. (2018), Shelley et al. (2020). The main studies that evaluated the UK market are only focused to forecast the future market returns using CAPE (Keimling, 2016) and do not investigate the stock returns behaviour.

The London Stock Exchange is considered to be one of the largest security exchanges in the world in terms of capitalisation and number of companies listed on the market (Lees 2012; Rojo-Suárez et al. 2020). It is also considered as one of the prestigious and oldest markets and it is ranked as one of the top five largest stock markets worldwide (Philips, Faseruk and Glew 2014). According to Gregory, Tharyan and Christidis (2013), London Stock Exchange is considered to have over-representation of small and illiquid stocks. The major institutional investors that make up a large part of the market are almost certainly not trading these stocks as part of their tradable portfolios. One way to overcome the liquidity issue in the London Stock Exchange is to provide upstairs market, which is practiced in major international markets except the London Stock Exchange (Gregoriou 2016). A major improvement that an upstairs broker offers, compared to standard one is the flexibility of large trade transactions outside the bid and ask quotes, which significantly improves the liquidity. Furthermore, evidence supports improvements in liquidity resulting from trading with limit-orders and voluntary deals (Gregoriou 2015). In the light of this criticism of London Stock Exchange, it would be interesting to conduct a detailed study involving the CAPE ratio in this market. For these points, the London Stock Exchange fits as a good non U.S. sample for a study on these issues.

Additionally, when comparing local and global versions of asset pricing models it is believed that localized versions can provide a more accurate explanation of local stock returns than globalized ones (Griffin 2002; Fama and French 2012). Thus, a new prospective of applying the two mainstream asset pricing models, CAPM of Sharpe (1964) and Lintner (1965) and the three factors model of Fama and French (1993) on time periods which have been highlighted by the CAPE ratio as under priced, overpriced or fairly priced may provide further insight that would lead towards the understandings of the efficiency of financial markets. If the behaviour of stock returns is not consistent to what these models predict, it may indicate that the performance of these models is not consistent across different market sentiments as highlighted by the CAPE ratio. In this analysis, the main variable to analyse will be alpha coefficient of asset pricing model in different subsamples and if there is any particular trend in theses subsamples. This will then lead to the counter argument that markets may not be efficient and there maybe arbitrage opportunities in the market, where arbitrageurs may make abnormal profits. If the stock returns are according to the systematic risk, it implies that there were few arbitrage opportunities but if stocks returns were not in line to stocks beta, this could lead to arbitrage opportunities where profits were available without due risk taking. If there are frequent arbitrage opportunities, this could lead to challenge the concept of market efficiency. A framework involving the CAPE ratio signals and the analysis of market efficiency in the subsequent time periods may provide a fresh insight into this debate.

1.4 The Aim of the Research

The main aim of this research is to analyse the signalling capability of the CAPE ratio and to analyse the performance of asset pricing models in different time periods highlighted by the CAPE ratio as overpriced, fairly priced and under priced market.

1.5 The Objectives of the Research

The objectives of this study are:

- To critically review the relevant literature on the CAPE ratio and asset pricing models, especially that is linked to market sentiments.
- To construct the CAPE ratio for the London Stock Exchange and examine how the ratio changed during the different market trends and to see its signalling capacity in terms of different valuation levels.
- To analyse the performance of the Capital Asset Pricing model in different market phases as highlighted by the CAPE ratio.
- To analyse the performance of the Fama and French Three Factors Model in different market phases as highlighted by the CAPE ratio.

1.6 Research Questions

To achieve the aim of this study, it is crucial to identify the research questions that this study intends to answer.

Q1. Is the CAPE ratio a useful signalling tool in classifying the market as under priced/fairly priced/overpriced?

Q2. Is the CAPM a suitable model in explaining assets behaviours in different market situations as classified by the CAPE ratio?

Q3. Is the Fama and French three factors model a suitable model in explaining assets behaviours in different market situations as classified by the CAPE ratio?

Q4. What can be the implication for the Efficient Market Hypothesis if the CAPE ratio provides credible signals about markets under-pricing, fairly pricing or overpricing?

1.7 Research Hypothesis:

1. H_0: the CAPE ratio cannot be used as a signalling tool to classify the market as under priced/overpriced

   H_1: the CAPE ratio can be used as a signalling tool to classify the market as under priced / overpriced

2. H_0: there is no change in the performance of the CAPM under different time periods within this study.

   H_1: the performance of the CAPM is not similar in different time periods under study.

3. H_0: there is no change in the performance of the Fama and French Three Factors model under different time periods within this study.

   H_1: the performance of the Fama and French Three Factors model is not similar in different subperiods within this study.

Table 1.1 Linking the research objectives with the research questions and hypothesis

Objective	Question	Hypothesis
To construct the CAPE ratio for the London Stock Exchange and examine how the ratio changed during the different market trends and to see its signalling capacity in terms of different valuation levels.	Is the CAPE ratio a useful signalling tool in classifying the market as under priced/fairly priced/overpriced?	The CAPE ratio cannot be used as a signalling tool to classify the market as under priced/overpriced
To analyse the performance of the Capital Asset Pricing model in different market phases as highlighted by the CAPE ratio.	Is the CAPM a suitable model in explaining assets behaviours in different market situations as classified by the CAPE ratio?	There is no change in the performance of the CAPM under different time periods within this study
To analyse the performance of the Fama and French Three Factors Model in different market phases as highlighted by the CAPE ratio.	Is the Fama and French three factors model a suitable model in explaining assets behaviours in different market situations as classified by the CAPE ratio?	There is no change in the performance of the Fama and French Three Factors model under different time periods within this study

1.8 Identification of Gaps in Literature and Research Originality

The focus of past studies on CAPE was in five main areas. First, it was on examining the CAPE ability to forecast future market returns (Tower 2012; Keimling 2016; Angelini et al 2018; Tolani et al. 2018; Shelley et al. 2020). Second, studies focused on improving the CAPE ratio formula like (Siegel 2016; Philips and Ural 2016; Philips and Kobor 2020). Third, they used CAPE as a sentiment indicator for investment decisions (Feldman et al. 2015; Asness et al. 2017). Forth, they used CAPE to examine and challenge the Efficient Market Hypothesis (Dimitrov and Jain 2018). Fifth, comparing CAPE with other indicators (Sturgess 2012; Tolani et al. 2018;). Studies that looked to the asset pricing models used it to evaluate securities or to determine what factors affect return (Bornholt 2013; Foye et al. 2013; Vo 2015; Rojo-Suárez et al. 2020).

While asset pricing models and the CAPE analysis have been studied on the U.S. equity market, the use of a non U.S. sample is essential because risk factors and asset pricing anomalies are also likely to be influenced by the specific equity market's institutional backgrounds and economic conditions. Since the London Stock Exchange is ranked among the biggest stock markets globally (Rojo-Suárez et al. 2020), it fits as a good non U.S. sample for a study. Furthermore, it is important to test the main asset pricing models in different markets as the presence of some local factors may also explain the variation of returns (Griffin 2002; and Fama and French 2012).

To the best of researcher's knowledge, there are not enough studies that test these mainstream financial asset pricing models characteristics in different subsamples (different time periods) as per the CAPE signals. The originality of this study is in sorting the time periods according to the signals of the CAPE ratio and then looking at the performance of asset pricing models from that angle. Moreover, these different market phases in the London Stock Exchange cover a rich sample period of a bullish stock market trend 2001-2007, two major financial recession periods 2000-2001 and 2008-2009 and a financial stability period 2010-2018. Using this unique sample, it would be interesting to test the predictions of Efficient Market Hypothesis and different asset pricing models.

1.9 Intended Contribution to Knowledge

The main contribution of this research would be to analyse the performance of the mainstream asset pricing models tested on different stock portfolios from a dataset from the London Stock Exchange and to provide fresh evidence of investment strategies for investors, regulators, and policymakers. Furthermore, it will also see the outcome of the CAPE ratio applied to the FTSE

100 index in the most recent time period including events, such as the sub mortgage financial crisis, will also be helpful in analysing the behaviour of stock returns. The expected contribution to theoretical debate is its fresh evidence to the Efficient Market Hypothesis by analysing stock returns in different periods in the context of the CAPE ratio signals.

Another contribution of this study would be the adopted methodology in analysing the efficiency of financial markets by testing the performance of the asset pricing models in subsamples built on the CAPE ratio valuation of the market trends. Secondly, the research results themselves represent an enrichment for the body of literature in providing new insight on the mainstream asset pricing models during different market valuations and subsamples.

Chapter four will identify the trading strategy using the CAPE ratio as a singling tool to enter and exit an investment position as compared to the buy and hold portfolio. This is intended to see if a trading strategy based on CAPE ratio can generate profits which are more than the buy and hold trading strategy. This will provide an insight to investors and policy makers on the signalling capabilities of the CAPE ratio. Testing the performance of CAPM will be covered in chapter five, in time periods which have been highlighted by the CAPE ratio as under priced, overpriced and fairly priced and linking it to the market efficiency as well. This offers a new prospective on the characteristics of this highly used model in practice during different market trends.

Chapter six will examin the performance of the Fama and French three factors model on the time periods which have been highlighted by the CAPE ratio as under priced, overpriced and fairly priced. The results of these models will be used to get inferences about the risk and return relationships leading to the general concept of market efficiency using the concept of arbitrage. This will provide a new prospective on the characteristics of this widely used model in academia during different market trends. These research findings will have relevance to contemporary finance debates as the dataset under examination includes one of the longest periods of stock market booms 2001-2007 and the worst economic recessions since the Great Depression 2008-2009. As such, this study will contribute to this important field of research by analysing market efficiency in this important time period and market.

1.10 The Thesis Structure

The thesis is divided into seven chapters. The introduction chapter has covered the background of the study, the statement of the problem that this thesis intends to solve, the purpose and objectives of the research, a justification for the work done, and finally a clarification on the research originality and on how this can contribute to knowledge. This is followed by the literature review chapter. It will cover the three main areas in literature that this thesis seeks to discuss, namely market efficiency, asset pricing models, and the cyclically adjusted price-to-earnings ratio. The methodology used in this study will be covered in Chapter 3. It will provide the reader a detailed view of the research framework, its context, the population and finally the data collection and the analysis. Chapter 4 will deal in detail with the analysis of the Cyclically Adjusted Price to Earnings (CAPE) ratio. Chapter 5 will cover the CAPE ratio signals and the analysis of subsequent returns in the light of the capital asset pricing model. Chapter 6 will cover the CAPE ratio signals and the analysis of subsequent returns in the light of the Fama and French three factors model. The final chapter will conclude the main finding of the research and will also identify areas of further investigation for researchers.

Chapter 2 - Literature Review

The previous chapter covered the rational of the study, study aim, objectives, and research questions. The main objective of this chapter is to review the existing literature in the context of the research problem and testable hypothesis. This chapter aims to review the literature on market efficiency and the anomalies that caused doubt on the efficient market hypothesis. It will also review the literature on capital asset pricing model and Fama and French three factors model. It will also review of the literature on the cyclically adjusted price to earnings (CAPE) ratio as it is used as a tool for classifying the market in terms of under, fairly or over valued in contrast to the EMH view that financial markets are efficient all the time. Finally, the testable hypothesis will be identified and reviewed in the light of other similar studies in literature.

This chapter is structured as follows. Section 2.1 reviews the existing literature on market efficiency and covers the evidence in favour of and against the validity of the EMH. Section 2.2 presents studies on the main asset pricing models; the single factor asset pricing model commonly known as the Capital Asset Pricing Model (CAPM) and the Fama and French three factors model. Section 2.3 reviews the empirical studies conducted on the signalling ability of the CAPE ratio. Section 2.4 covers the hypothesis framework. Section 2.5 provides the conclusion of the chapter.

2.1 Market Efficiency

According to Dimson and Mussavian (1998), the concept of an efficient market hypothesis (EMH) emerged from Bacheliers' doctoral thesis in mathematics presented at the Sorbonne in 1900. In the late 1950s, Paul Samuelson circulated it among economists and Cootner (1964) published it in English. Bachelier (1900) concluded that commodity prices fluctuate randomly.

Working (1934) and Cowles and Jones (1937) show that US stock prices and other economic series follow the pattern identified by Bachelier. Furthermore, Cowles (1933) found that it is not possible to beat the market. Consequently, Dimson and Mussavian (1998) report that in the 1940s that there was evidence supporting the efficiency of the weak and strong form of information efficiency except that these categories would not have been in use until the 1970s.

Fama (1970) defined the efficient market as a market in which prices fully reflect all available information. He argues that for a market to be efficient, three conditions must be met: i) trading in securities without transaction costs; ii) market participants have free access to all available information; iii) a common agreement among all market participants on how each security is affected by information on current prices and future price distributions.

Market efficiency was classified into three forms (Fama 1970). A market will be classified as weak form of information efficiency where asset prices reflect all historic information available in the market. Hence, abnormal returns cannot be achieved using technical analysis. This form is coherent with the random walk theory that hypothesises the randomness in price movements and the independence of their changes from one another. A market will be classified as semi-strong form efficient if asset prices reflect all publicly available information, for example, dividend announcements, earnings, and so on. Finally, a market will be classified as strong form efficient if asset prices reflect public and private information as well.

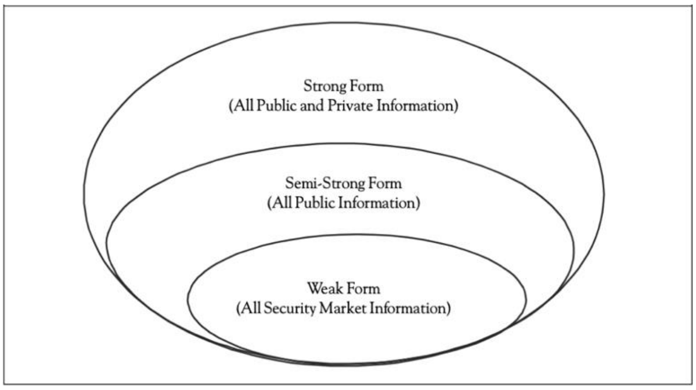

Figure 2.1 Forms of market efficiency
Source: (Naseer and Tariq 2015)

Moreover, Fama (1970) supports that the USA equity markets can be classified as the weak and semi-strong form efficient as the tests of weak and semi strong form of efficiency cannot be statistically rejected. Due to the purely theoretical nature of strong form of market efficiency, there are no credible tests to assess the strong form of market efficiency. Two anomalies have been identified to reject the strong form efficiency; security exchange specialists and corporate insiders both seem to have monopolistic access to information.

Shiller (1980) shows that changes in stock price indices are much greater than changes in dividends, which suggests that the new information cannot justify the volatility of stock price indices. Shiller (1980) concludes that only if the potential real price movements were significantly greater, would potential real dividend movements be acceptable to justify real price fluctuations as a reaction to new one's information on dividend movements. Furthermore, Shiller (2003) questioned the credibility of the model’s predictions of efficient markets after the extreme stock price fluctuations of the 1980s.

Stock-return variations has been used for testing and proofing the efficiency of the market (Shiller 1981). In certain events, the presence of extreme volatility or quickly shifting security-returns variation was used as evidence to support a random walk that presumes a failure in forecasting security's values or to achieve abnormal returns. However, the findings of the empirical experiments Shiller (1981) carried out lead le to accept the random walk theory. Perhaps because of the lack of rationality in the market as described by Shiller (1981) or the data quality used in the analysis. Also, Fama and French (1988) and Lo and MacKinlay (1988) rejected the random walk hypothesis in developed financial markets.

Fama (1998) explains anomalies as some phenomenon that cannot be explained logically or in the light of some theoretical model; however, he refuses to abandon market efficiency based on such evidence because it is equally common for stock prices to overreact or under-react to information. Additionally, Fama (1998) argues that it is not uncommon to see an abnormal continuation of returns and also the opposite. Besides, Fama (1998) states that anomalies, in the long run, diminish due to their weakness and changes in the way they are revealed. However, Shiller (2003) states that when most of the unpredictability in stock markets was inexplicable, the credibility of the efficient market hypothesis was called into question, such anomalies can be seen as a kind of take-off from market efficiency.

Shiller et al. (1984) argue that describing the present value of optimal estimated future real dividends as the real stock price is a historical error in economic thinking. Shiller (1988), states that due to the continuation of unusual price increases, market investors were fearful of approaching a market correction, such abnormal investor mentality was one of the elements that triggered the correction in the US stocks market during 1987. Consequently, Shiller (1988) believes that on 19 October 1987 investors assumed that the decline in stock prices was the beginning of a market crash and that precisely this panic among investors led to the rapid decline of the market in 1987. The Dow Jones industrial index single day 20% crash in 1987 casts a shadow at the validity of the EMH (Naseer and Tariq 2015).

The theory that stocks market fluctuations could not be projected was checked and rejected by Harvey and Whaley (1992). The results of their study indicate the predictability of stock-return. The conclusion was that considering the precision of the volatility forecast in Harvey and Whaley (1992) study, abnormal returns could not be generated. It was also concluded that the volatility dynamics are compatible with the Effective Market Hypothesis.

Shiller (1990, 2003) explained that the creation of a bubble in the stock markets is due to an increase in the demand for shares and the intent of successful and unscrupulous investors to profit from the subsequent increase until the bubble itself eventually bursts.

Between 1935 and 1994, Hudson et al. (1996) examined the weak form efficiency in stock prices in the UK testing technical analysis tools applied by (Brock et al. 1992), to evaluate if past price movements could be used in generating future profits higher than a buy and hold strategy returns. Brock et al. (1992) used the Dow Jones Index to exploit moving average and trading range breakout rules to ratify the technical analysis predictive power in obtaining excess market returns. Their findings confirm an abnormal return from their technical based trading strategy, which led to the conclusion that the process of a random walking is not followed in the Dow Jones Index. The technique was applied on the United Kingdom Financial Times Industrial Ordinary Index by (Hudson et al. 1996), their findings opposed (Brock et al. 1992) results, which asserted that the application of technical analysis tools does not help investors in making surplus returns except if a series of long-term stock indices are considered. To put it differently, randomness is possible in a short-term series, however a serial correlation can exist in a long-term. While using a long-term series as a practical investment strategy may impact the reliability of trading rule.

According to Szafarz (2012), the relation concerning the idea of market efficacy and uncertainty depends on the investment perspectives and market traders' structure. If the market was controlled by fundamental traders that have a limited speculation, the activity of buying and holding stocks for a long term would generate an illiquidity in the market, and because of the tension generated high volatility will occur. Speculators, fundamentalists, regain faith in the expectation that the stock prices will return to its long-term fundamental worth. As Szafarz (2012) argued that market uncertainty decreases with an upsurge in investors trading on the market.

The empirical and theoretical literature show mixed evidence about the EMH (Naseer and Tariq 2015). Additionally, anomalies have been highlighted in many global market's studies such as different calendar effects examined in a variety of literature like Ariss et al. (2011). These scholars explore calendar incongruities in the Gulf Corporation Council. They conclude that the returns tend to peak on Wednesday and that this effect is less pronounced during Ramadan. An investigation by Floros and Salvador (2014) focused on the DOW and the monthly cyclical effects of stock and cash index futures returns for the period between 2004 and 2011. Alt, Fortin and Weinberger (2011) acknowledge the noteworthy 1970s and 1980s

Monday effect in Germany and the U.S. Nonetheless, it seems as if the effect no longer existed in the 1990s and 2000s.

Kumar (2015) examined the turn–of–month effect in the Indian currency market by testing different currency pairs from 1999 to 2014. Kumar's tests indicate the existence of a significant effect, yet they suggest that it is not possible for investors to make extra gains by advantaging from the turn–of–month effect. Week–of–the–year effect (Levy and Yagil, 2012). Day–of–the–week effect (Berument and Dogan, 2012; Kumar and Pathak, 2016). Monthly or January effect (Agnani and Aray, 2011; Dbouk, Jamali and Kryzanowski, 2013; Kumar, 2016; Kumar, 2018). Turn-of-the-year effect (Lynch, Puckett and Yan, 2014).

In his review on stock market anomalies, Schwert (2003) argues that even if potential arbitrage opportunities exists theoretically it may not be easily possible to exploit these anomalies practically due to trading costs. Recent research supports such argument, as many studies conclude that the opportunities of profitable trading are not possible on many recognised anomalies (e.g., Chordia, Subrahmanyam, and Tong (2014), Green, Hand, and Soliman (2011), Richardson, Tuna, and Wysocki (2010), McLean et al. (2014). Thus, the notion of an efficient market is consistently supported by these recent studies.

Milian (2015), used a data sample of earnings announcements for stocks that have active options traded in the U.S. markets for the duration from 1996 to 2010 in testing arbitrage opportunities. The results show that abnormal returns are significantly negatively related to their earnings news. However, when the test was applied on a data set from 1974 to 1995 a positive significant autocorrelation between earnings news and abnormal returns. Such, results show that in the more recent time period, there is an improvement in information efficiency.

Satish (2017) reviewed different calendar anomalies in both currency and stock markets, he argues that recently those anomalies nearly disappeared. The absence of a coordinate and competitive market maker continually operating all day in the 80s and 90s could have been behind arbitrage opportunities present in those anomalies in currency markets. Satish concludes that the more informative investors experience, information technology advancements and advancements in market operations have contributed to the weakening of those anomalies in the markets.

Greenwood, Shleifer and You (2019) used two data sets to test the possibility of the presence of bubbles in stock prices. Using industry portfolios, the first set was monthly US industry returns for the period 1926 to 2014. The second set was monthly international sector returns for the period 1985 to 2014. The CAPE ratio was one of the indicators used to identify price run-ups. Over their data sample 40 cases are identified in the US sample and 107 in the international sample in which over the past two years market returns exceeded 100% and a 40% or more of a price correction occurred. They concluded that CAPE works better with the international data sample in predicating excess and raw returns.

One of their findings was that an industry portfolio sharp rise on average does not forecast a future decline of returns, which is in line with (Fama 2014). Yet, they predict an increased chance of an upcoming market crash, which can be seen as evidence against (Fama 2014). Furthermore, the article shows that some of the portfolio characteristics help in predicting future returns. An observation of their portfolios shows that basing them on industry produces a variety in portfolios sizes some are small, and others are big. Additionally, the rules they applied by setting a high bar of 100% increase in returns and the two-year condition misses out on smaller market run-ups that can still be considered as bubbles, which can increase their studied cases. In addition, the 40% crash disregards flash crashes that occur with a less correction.

According to Schatz and Sornette (2020), the phrase asset price bubble characteristically denotes a context in which an asset's market price is higher than its fair price, which is known as the fundamental value of the asset. Literature relating to asset pricing bubbles falls into two primary paradigms. The first paradigm contains those bubbles occurring in efficient markets, and the second relates to bubbles that can be attributed to conduct that violates market efficiency. The phrase used to describe the first category is rational expectation bubbles. The phrase denotes the concept of over-valuation of assets – seen as an inefficiency – within a market that is otherwise efficient. The second group of bubbles are attributed to market efficiency breaks in relation to perfect information-rational expectations.

Financial crises and bubble occurrences are results of vague information, irrational behaviours or certain limitations on rational traders would have otherwise employed to arbitrage due to pricing inefficiencies that could result in prices remaining distorted for extended periods. So, even if a market has been proven to be efficient it can go into cycles of inefficiency.

Loewenstein and Willard (2013), if an asset future dividend lowest superreplication cost is exceeded by the asset's price the asset is in a pricing bubble. Bubbles for some are characterized as speculative phenomena where the hope of profiting from the sale of an asset makes investors buy the asset at a price that exceeds the value of the asset's stream of the dividend. Based on that, if the fundamental value of an asset is less than the asset price, a bubble in assets price would develop.

Supporting the notion that stock markets fluctuate from efficiency to inefficiency. Choudhry and Jayasekera (2015), tested the switch in the UK equity market from a good period to a bad period. They used 25 stocks from five major industries in the UK stock market, Banking, Retail, Food, Construction and Oil industries, for the period 2004 to 2010. Their results show that as the market shifts from good to bad its efficiency level significantly declined. Theoretically, for investors the implication of such shifts to a crisis period in the market are chances of arbitrage gains. Yet, generalizing the findings may not be feasible due to the small number of stocks compared to the size of the equity market in the UK.

Jones (2016) states that, when investors base their investment decisions solely on their ability to sell an asset in the future after purchasing it without any consideration of its fundaments, their act leads to the existence of an asset bubble. Due to the difficulty of separating between rational and irrational investor’s response to lowering risk, the speculative bubbles identification is still in an experimental state.

In accordance with Cooper (2008) it is imprudent to prevent the creation of excessive credit and bubbles in asset prices. Moreover, Cooper concluded that seeing a bubble in its creation phase is impossible and cannot be detected. However, Phillips, Wu, and Yu (2011) implemented a method to discover exuberance in a series of asset prices, which can signal a bubble in its formation stage. It is important to detect such action in its early stage by policy makers to prepare appropriate economic policies against such financial disorder.

As, Phillips, Shi and Yu (2015) highlighted, often prior to a financial crisis a rampant credit growth or an asset market bubble occurs. Thus, more policymaker’s attention has been made to controlling excessive credit creations after the subprime mortgage financial crises. Phillips, Shi and Yu (2015) implemented a testing framework that is an improvement on (Phillips, Wu, and Yu 2011) method to assist in bubbles surveillance. In order to test for the existence of bubbles they propose a generalized sup ADF (GSADF) method together with a recursive backward regression procedure to time-stamp the bubble start and extinction dates. The method was applied to the price-dividend ratio of the S&P500 from January 1871 to December 2010, and it was able to successfully confirm all the historical bubbles in the sample.

Author Name	Main Focus of study
Bachelier (1900); Working (1934); and Cowles & Jones (1937); Fama (1970); Dimson & Mussavian (1998); Fama and French (1988); Lo and MacKinlay (1988); Fama (1998)	The foundation and support for the EMH
Shiller (1980); Shiller (1981); Shiller et al. (1984); Shiller (1988); Hudson et al. (1996); Schwert (2003); Richardson, Tuna, and Wysocki (2010); Green, Hand, and Soliman (2011); Agnani and Aray (2011); Ariss et al. (2011); Fortin and Weinberger (2011); Levy and Yagil (2012); Berument and Dogan (2012); Dbouk, Jamali and Kryzanowski (2013); McLean and Pontiff (2014); Chordia, Subrahmanyam, and Tong (2014); Lynch, Puckett and Yan (2014); Floros and Salvador (2014); Kumar (2015); Naseer and Tariq (2015); Kumar and Pathak (2016); Kumar (2016); Satish (2017); Kumar (2018)	Tests of anomalies in the light of the EMH and the ability to make profits from them
Choudhry and Jayasekera (2015); Milian (2015)	Market fluctuation from efficiency to inefficiency
Szafarz (2012); Jones (2016)	Investor's behaviour led to the change in market valuation
Shiller (1990); Shiller (2003); Cooper (2008); Phillips, Wu, and Yu (2011); Loewenstein and Willard (2013); Phillips, Shi and Yu (2015); Greenwood and Shleifer (2019); Schatz and Sornette (2020)	Predicting market movements and the formation of bubbles

Table 2.1 Summary of EMH literature

2.2 Asset Pricing Models

For stock market investors risk evaluation and some idea of future stock price movements are of crucial importance. Therefore, an investor should recognise the factors that may affect stock prices and their returns. Sharpe (1964) argues that when determining an asset price, investors are faced with two variables. The first is the risk-free rate that represents an investor's anticipated interest from an investment that contains no risk at all within a specific period. The second is the reward of risk undertaken by an investor when investing in a stock. It is very important for investors to have an idea of how to correctly measure the relevant risk of a security. Sharp (1964) and Lintner (1965) worked to establish the theory of asset pricing, which resulted in the form of the Capital Asset Pricing Model (CAPM). The CAPM should be well comprehended prior to analysing more complex models as it is considered the basic asset pricing model (Schulmerich et al. 2015).

According to Hodnett and Hsieh (2012), within an efficient market, the CAPM represents a single-factor model assisting investors in deciding assets' equilibrium rates of return in an efficient market. CAPM was considered an extension of Markowitz (1952) contribution. The model classifies risk into two categories, systematic risk and unsystematic risk. Systematic risk, that is measured by beta (β), is defined as the overall stock market risk, which cannot be eliminated, while unsystematic risk is the specific risk of companies that can be eliminated by diversifying the shares in a portfolio.

The relationship between the risk and the expected return of an investment is a financial fundamental issue in finance. According to Markowitz (1952), the market beta (β) is the measure of the risk of the asset and for an investor to benefit from the market, he would have to bear the market beta, so that the variation in market risk is the change in the expectation of return. The Capital Asset Pricing Model (CAPM) was built on the collective work of Sharpe (1964), Lintner (1965) and Mossin (1966). Providing the first coherent framework for addressing the fundamental issue of determining the relationship between risk and return (Perold, 2004).

In accordance with the model, an investor should expect additional return as he is willing to take systematic risk when trading on the market. The model then indicates the expected return for an asset is the sum of the risk-free rate (r_f) and the asset's risk, which amounts to (β), multiplied by the excess return on the market which, in turn, is equal to the difference between the market return (r_m) and risk-free rate (r_f). Formally we have: $r_i = r_f + (\beta)\ (r_m - r_f)$.

The CAPM is based on the assumptions that markets are efficient, the price of a share reflects its accurate value, risk aversion and investor rationality, which means that portfolios are valued according to their expectations of yield and standard deviation, the absence of transaction costs, investments held over the same period of time, the normality of the distribution of asset returns, asset holders have expectations of homogeneity for their returns and the affordability of an interest rate loan risk-free for investors.

According to Fama and French (2004), CAPM focuses on three propositions relating to the relationship between market beta and the returns expected as indicated by the model:

i) The relationship between anticipated returns on all assets and their betas is linear. Moreover, beta provides a full measure of a stock's risk, meaning that no other way of measuring risk can be expected to explain the variances in average returns across stocks that the CAPM has not explained.

ii) The risk premium is positive, implying that a market portfolio's anticipated return is higher compared to that of assets that do not have a correlation with the market return.

iii) In the model's Sharpe-Lintner form, the expected returns of assets with returns that are not correlated with the market are equivalent to the risk-free rate. Furthermore, the beta premium is equivalent to a market portfolio's anticipated return if the risk-free rate is subtracted.

Nonetheless, there are considerable obstacles faced by researchers who attempt to empirically test these relationships. One such obstacle is related to the reality that it is impossible to observe a market portfolio. This makes it impractical to adequately test the model (Roll, 1977). However, the CAPM can be tested using a mixture of universal or conventional least-squares methods (Guermat, 2014).

A second obstacle is noted by Ferson and Jagannathan (1996), who says that where the full details about the market betas and expected returns are available, the CAPM can be examined by approximating the empirical relationship between the betas and the expected returns, determining whether there is a linear relationship. Nonetheless, even this method faces the obstacle that the expected returns and betas are not observed or known and need to be approximated. The challenge with this is the "error-in-variable" bias that could negatively impact the outcome of empirically testing CAPM.

When attempting to empirically test CAPM, scholars resort to the equation below, which needs betas (βi) to be approximated and employed as the primary independent variable:

$$R_i - R_f = \gamma_0 + \gamma_1 \beta i + \mu_i \qquad \text{(A)}$$

From the CAPM, it can be inferred that the intercept (γ_0) has to be equivalent to zero for each tested asset. Also, the slope (γ_1) applied to the approximations has to be positive and equivalent to the average market risk premium. Notwithstanding the reality that the CAPM is theoretically pure, existing tests were not conclusive (Douglas, 1969; Black et al., 1972; Fama and MacBeth, 1973).

The inconclusive results may be explained by noting the reality that any CAPM econometric test is a joint hypothesis merging the theory's elements with ad-hoc presumptions about variables that cannot be observed (Crotty, Epstein and Wolfson, 2013). In relation to this, Fama and French (2004) advance the view that one way of explaining the failure of the CAPM noted in several studies like Douglas (1969) is that the researchers utilise individual stocks that could result in them being susceptible to the “errors-in-variables” bias. Consequently, aiming to deal with this challenge, Black et al. (1972) resort to the use of portfolios as opposed to individual securities when they approximate betas for portfolios that are diversified. Even then, other scholars like Ang et al. (2010) call for caution when using this solution by noting that the utilisation of portfolios as test assets will not result in smaller standard errors of cross-sectional coefficient estimates. These scholars support this view by noting that the construction of portfolios destroys data because it shrinks the distribution of betas, which could result in bigger standard errors. It is on this basis that the authors advance the view that the use of individual stocks makes it possible to conduct efficient tests of whether factors are priced. It is thus apparent that none of the two approaches is perfect, and the advantages and disadvantages of each will need to be analysed before any is chosen.

Notwithstanding the challenges with regard to empirically testing CAPM, Mossin (1966) agrees that a rational investor can eliminate the business risk in a market by diversifying his investment. Furthermore, Jensen et al. (1972), undertook empirical tests of CAPM and concluded that the” systematic factor (β) seems to be an important determinant of security returns” which supports the model. Moreover, Jensen et al. (1972) and Miller and Scholes (1972) used the CAPM to test the US market from 1931 to 1965 and concluded that stocks with a lower (β) value outperformed the CAPM forecast while stocks with a higher (β) under-performed those. According to Fama and MacBeth (1973) who tested the CAPM, the (β) and return show a linear relationship that would demonstrate the accuracy of the model. As Levy (1983) has shown, the Security Market Line (SML) is a graphical representation of the linear relationship in CAPM in which different levels of market risk are plotted against the entire market return over a specific time interval.

Regarding CAPM testing, Fama and Macbeth (1973) deliver the most crucial evidence. The methodology they employ has become a leading approach for people who want to test models connected to asset pricing. When they test the model, the two scholars employ the extension of the Security Market Line equation below:

$$R_{it} = \gamma_{0t} + \gamma_{1t}\beta i + \gamma_{2t}\beta i^2 + \gamma_{3t}si + \varepsilon_{it} \qquad \text{(B)}$$

In their attempt to test whether expected returns can be determined using variables other than beta, Fama and Macbeth (1973) introduce two more variables that can determine expected asset returns. Among the added variables, the squared market beta ($\beta_i{}^2$) is the first. This variable is added to test if there is a linear relationship between the market beta and expected return. The standard deviation of the residuals (si) is the second added variable. This variable aids in testing whether the market beta provides a full measure of the risk required to justify returns. Given Equation (B), four hypotheses presented below are tested:

1) Linearity suggests that $E(\gamma_{2t})$ = 0, and this infers that the relationship between risk and expected return is linear.

2) No systematic effects of non-β risk, i.e. $E(\gamma_{3t})$ = 0, and this suggests that beta is a complete measure of a stock's risk.

3) A positive expected risk-return trade-off, i.e.$E(\gamma_{1t})$ > 0, suggests that risk when investors are risk-averse, they should require a positive premium for beta risk.

4) The Sharpe-Lintner hypothesis, i.e. $E(\gamma_{0t})$ = R_{ft}, infers that the intercept should be approximately equal to the average risk-free rate.

To test the hypothesis presented above, Fama and Macbeth (1973) proposed a method that involved a series of steps. They start by dividing the aggregate sample period: 1926 to 1968. They create nine analysis epochs that overlap. This is followed by a further division of each period into three sub-period: portfolio formation, beta estimation, and testing. The first sub-period involves approximating individual security returns' time series regression against a proxy for the market portfolio. This makes it possible to attain estimates of individual securities betas. These portfolios are then classified on the basis of their beta coefficients. This is followed by re-estimating the portfolios using data from the five years that follow in the initial period of estimation to remove any possible measurement error bias. The task that follows is the calculation of the portfolios' monthly returns during the period of testing. For each month in the period tested, a cross-sectional regression is run. This involves regressing the monthly returns against beta, beta squared, and unsystematic risk is estimated on the basis of the previous five years of data (Schulmerich et al., 2015). Then the pricing error and risk premium are provided with simple time-series averages of period-by-period estimates (Goyal, 2011).

Fama and Macbeth's (1973) study above produced results that back the two-parameter model's testable implications. From the results, it can be noted that expected returns cannot be affected by any other measure of risk in addition to beta. Moreover, the linearity assumption is supported by the fact that the squared betas' coefficient is statistically insignificant. From the results, it is also revealed that a positive trade-off between return and risk exists. This assumption is supported by the significantly positive coefficient of the approximated risk premium for the cross-sectional regression. However, this coefficient is below the historical average risk premium. Nonetheless, the risk premium's coefficient exhibits a significant variability from one month to the next, which could be read as evidence that a time-varying risk premium exists.

Even though the conclusions that were drawn by Fama and Macbeth (1973) back the CAPM, numerous empirical researchers have presented evidence debunking the CAPM's validity. Black (1972) has made a valid argument that a risk-free investment is not possible. Furthermore, the assumption that the market is perfect was rejected due to the existence of barriers to short selling of assets and the cost of the investment loan. So, Black made the CAPM more realistic by eliminating it is unlikely presumptions to test asset returns. Since stocks are represented by the market risk factor in the market, Black used a group of a large number of assets (β) to replace a single asset (β). The result strongly rejects the CAPM hypothesis because systematic risk alone cannot explain the expected return on assets.

Ross (1977) also found that the corporate short-selling constraints that might be attributed to bankruptcies and the existence of financial intermediaries that could impose hurdles such as trading rates or brokerage fees would have an effect on the CAPM single factor validity. Other studies such as Basu (1977), Banz (1980), and Jegadeesh (1990) have tested the CAPM and found that the return of an asset is not determined only by the market risk factor, but also there are other factors that influence it, which the model does not report.

The research by Fama and French (1992, 1993) is among these studies. These scholars are considered to have produced some of the leading works questioning CAPM’s empirical validity. The scholars used a sample consisting of stocks from non-financial firms listed on three stock exchanges: NASDAQ, AMEX, and NYSE. Their study covered the period between December 1962 and June 1990. They concluded that the cross-section of average stock returns is not explained by beta. Such a conclusion is in keeping with that of Reinganum (1981), who concludes that in the period 1963 and 1990, the relationship between average returns and beta disappeared.

Bartholdy and Peare (2005) applied the CAPM on different indices using different data frequencies and time intervals with an equal weighting index and concluded that the model could explain only 3% of the changes in stock returns. Dalgin et al. (2012) and Bilgin and Basti (2014) tested the CAPM on the Turkish stock market showing that the model was ineffective and unsuitable for predicting returns.

Notwithstanding the criticism directed at it, CAPM is an extensively used model in previous literature (Bozec et al., 2014). Some of the scholars that resorted to CAPM in attempts to determine the connection between the cost of capital and corporate governance include Khan (2016), Bozec et al. (2014), and Pham et al. (2012). An analysis of available literature suggests that the majority of firms prefer the CAPM when attempting to approximate the cost of equity. For example, 73% of firms responding in a study done by Kester and Change (1999) used the model when approximating their cost of equity in the Asia-Pacific Region.

Truong et al. (2008) did a similar study, which concluded that 72% of respondents resorted to CAPM when approximating the cost of equity. According to a study by Graham and Harvey (2001), when doing capital budgeting, 74% of participating U.S. companies indicated that they chose CAPM. Berk and Van Binsbergen (2017) did an empirical study, which concluded that the CAPM is used by investors in discount rate calculations. Additionally, using CAPM is recommended as it is most consistent with the behaviour of investors (Levy 2010; Berk and Van Binsbergen 2017).

Bornholt (2013), test three main empirical anomalies that the CAPM is facing using 48 U.S industries monthly returns for the period July 1963 to December 2009. The first challenge is that portfolios with low beta stocks average returns are higher than CAPM's prediction; portfolios with high beta stocks average returns are lower than CAPM's prediction. The second challenge, securities with a high-value ratio have a higher average return compared to those with a low-value ratio. The last challenge, firms that had large returns in the last six to twelve months tend to have higher returns over the next year compared to those that had a low recent return.

Bornholt sourced the data from Kenneth French's website. For testing CAPM they sorted industries into 8 portfolios based on their beta with the first portfolio holding 12.5% of industries with the lowest past beta and the eighth portfolio holding the 12.5% of industries with the largest past beta. What can be noticed from the study's results is that the CAPM showed an empirical failure when it is applied to industries. Also, the subsample from 1993 to 2009 shows that the beta anomaly tends to diminish in recent years, but the value and momentum anomaly still exists. Hence, this is a strength of the CAPM when compared to multi-factor models.

Hundal, Eskola and Tuan (2019), used the CAPM to examine the risk and return relationship and to test the over or underperformance of stock returns. Their analysis involved using regression to test a sample of 90 stocks from the Helsinki stocks exchange for the period from 2012 to 2016. Their results reveal that on average stocks actual earnings are more than their forecasted earnings. Additionally, there is an insignificant and weak relationship between total risk and return. Yet, the beta and return relationship was found to be significant.

Belesis, Sorros and Karagiorgos (2020), used the CAPM on securities in the S&P 500 to test the role of financial data compared to accounting data. The sample was for the period 2002 to 2017. They concluded that the role of financial data is more significant than accounting data. Furthermore, after the financial crisis, the period after 2009 the estimations differences in correlations and absolute errors favour the CAPM.

Rojo-Suárez, Alonso-Conde and Ferrero-Pozo (2020), used a sample from the London Stock Exchange ranging from 1989 to 2018 to test whether the increase in liquidity and trading activity can improve the CAPM. They used portfolios sorted in accordance with different market anomalies. Their results show that CAPM results have improved with the high liquidity in the market, and they are close to those of the Fama and French models. Yet, this needs to be applied and tested in other markets to determine its commonness.

Jensen (1978) advances the view that in the literature related to economics, accounting, and finance, the Efficient Market Hypothesis is accepted without questioning. Nonetheless, there is escalating empirical evidence showing that there are many irregularities in the market that cannot be explained by the Efficient Market Hypothesis. Examples of such anomalies include predicaments such as the value effect, size effect, and momentum noted in stock returns. Anomalies in the financial market have led to a robust debate among finance scholars with regard to their interpretation (Hawawini and Keim 1998). There exists a group of scholars who believe that the presence of anomalies is proof of the fallacy of the idea of market efficiency. However, it is possible that the results could be an indication of the failure of the fundamental model used in pricing the assets like the CAPM to fully describe equilibrium price formation. It is on this basis that some have noted that anomalies can be the best way of determining the direction of future research (Frankfurter and McGoun 2001).

Using the NYSE, Banz (1981) focuses on the period 1926 to 1975 to provide the inaugural organised proof of the presence of size effect in the common stock market. The same author conducts an empirical examination of the connection between the aggregate market value of a firm's common stock and its returns. This is accomplished by employing the generalised asset pricing model below. The model suggests that a common stock's expected return is a function of risk, β and the equity market value, Φ.

$$E(R_i) = \gamma_0 + \gamma_1\beta_i + \gamma_2[(\Phi_i - \Phi_m)/ \Phi_m]$$

where Φi represents the stock's market value, i, and Φ_m is the average market portfolio value. In a manner that contrasts the CAPM conjecture that beta is a full measure of risk, the outcome indicates that γ_2 is significantly negative, implying when compared to firms with large market values, firms that have small market values tend to produce higher returns on average.

Also, Stattman (1980) study found a positive relationship between the returns of stocks and their book-to-market in the US equity markets. Furthermore, test results by Rosenberg et al. (1985) reveal that stocks with a low book-to-market value perform higher than high book-to-market stocks. The observed size effect in the U.S. market is also widespread in other markets. Results from a study by Rouwenhorst (1999) involving 1,705 companies from 20 emerging equity exchanges illustrate the reality that small stocks often perform better than large stocks.

According to Dijk (2011), analysis of international market study results presents a robust argument disapproving concerns relating to data mining. Nonetheless, as Horowitz et al. (2000), shows there is a thread of empirical studies advancing proof supporting the conclusion that after it was discovered in the 1980s, the size effect would later disappear. Certain scholars like Horowitz et al. read this to mean that size should not be included among systematic risk factors, nor is it a proxy for risk in all sample periods. It is on this basis that these scholars approach the prevalent employment of size as an explanatory variable for stock returns with caution. Certain scholars like Hou and Dijk (2008) posit that the size effect still exists. Such views have resulted in revolving studies into the fundamental causes of the size effect.

The inaugural class of rational asset pricing elucidations attribute the size effect to the accuracy of CAPM beta estimates. The argument advanced by Roll (1981) is to the effect that the size effect could be the statistical outcome of inaccurate beta measures attributed to the fact that small stocks do not trade as frequently as the large ones. Nonetheless, Reinganum (1982) posits that the risk estimates bias as a result of non-synchronous trading is not adequate to elucidate the noticeable size effect. Consequently, researchers have shifted their focus in the direction of exploring the impacts of non-market risk factors with the aim of explaining the size effect within a rational setting.

A study by Chan et al. (1985) concluded that the size effect is an important factor in multifactor asset pricing model. This explanation posits that if the returns of small firms are higher, it is because they are being compensated for the added risks endured in an efficient market. Thus, Chan and Chen (1991) attempt to determine the reasons smaller firms present a higher risk than larger ones. They conclude that the financial performance of small firms tend to be weak as these firms are often not run efficiently, and their financial leverage is higher. This acknowledges the assumption that smaller firms are risker than big firms and that it would be impossible to capture this risk using a market index heavily weighted towards big firms.

The value effect is another anomaly that has robustly challenged the CAPM. Investment practitioners and academics have sustained the view that value strategies perform better than the market (Lakonishok et al. 1994). The basis of such value strategies is the purchasing of stocks with low prices compared to various measures of value, including book assets, dividends, and earnings. The prevalent employment of value strategies by practitioners has spurred scholars to conduct studies determining the actuality of the value effect in various markets and epochs, with the aim of delivering a rational elucidation of this anomaly.

The inaugural study testing the proposition that variables linked to value could explain cross-sectional variations in expected returns was conducted by Basu (1977). The study conducts an analysis to determine if the investment performance of common US stocks is connected to earnings-price (E/P) ratios. The study's outcome indicates that when stocks are divided over five portfolios based on their E/P ratios, the returns of low E/P portfolios are lower compared to those of high E/P portfolios. Nonetheless, in a manner that debunks the capital market theory, such higher returns are not linked to a higher degree of systematic risk in the manner measured using the CAPM beta. Market inefficiency is the concept used by Basu (1977) to explain the findings above. This conclusion cast shadow on Ball (1978), who argues that a conclusion such as this one is erroneous if one considers that market efficiency tests denote joint Efficient Market Hypothesis tests and a specific assets pricing model. Considering the views of Bell (1978) the results presented by Basu (1977) may be read as an acknowledgement that CAPM does not fully explain the equilibrium risk-return link. This may be an indication of the misspecification of the model as it overlooks other pertinent risk factors. Ball (1978) claims that owing to the inverse relationship between discount rates and market values; the E/P represents a proxy for all omitted risk factors in expected returns. Suppose the book value is held constant in the numerator, a company's B/M ratio has a tendency to with increasing expected return and risk (Lewellen, 1999).

Ball's (1978) argument is supported by Fama and French (1992), as their results indicate that variables like earning-price ratio, leverage, book-to-market ratio, and firm size have a significant predictive ability for expected returns as an indication that CAPM is a misplaced model. Using their seminal paper, these scholars report the cross-section of average stock returns can be significantly explained by book-to-market ratio. They also add that these two variables can absorb other variables' explanatory power like leverage and E/P ratios.

Nonetheless, these scholars share the advice that the rationale for using these conclusions relies on two vital elements:

i) Whether these results are a consequence of chance or they are able to hold in the future.
ii) Whether rational or irrational, asset pricing is the basis of these results.

These two provisos have resulted in a proliferation of studies aiming to debunk or support their results. Scholars who have conducted this research include Fama and French (1998), who have attempted to deliver out-of-sample proof regarding the actuality of the value effect. They conclude by refuting the concerns related to data mining. The same scholars also test whether a significant value premium exists. Their study covers the period 1975 to 1995 and 13 countries. From their conclusions, it can be noted that international returns show evidence of a consistent value premium. They also broadened the analysis to include 16 emerging economies, and the results show the existence of a value premium in the added markets. It is from these results and others before them that they conclude that there is evidence of the actuality of a value premium in stocks.

Based on past results, it can be posited that multifactor pricing models deliver crucial discernments explaining the size effect. Fama and French (1992) are some of the scholars supporting the view of the multidimensionality of stock risks, where the proxy for one dimension of risk is a book-to-market ratio and the other by firm size. It is on this basis that Fama and French (1993) posit their three factor model augmenting the CAPM with two mimicking portfolios designed around book-to-market ratio and firm size with the aim of accommodating the anomalies CAPM is unable to capture. Notwithstanding the fact that Fama and French's model is popular, Chou et al. (2010) argue that it does not completely account for cross-sectional regularities linked to book-to-market ratio and firm size. This is because the model does not explicitly specify the fundamental economic rationale for including two mimicking portfolios created using book-to-market ratio and firm size.

In the same vein, Berk et al. (1999) propose that a vibrant progression of systematic risks provides an encouraging explanatory power source for comprehending various anomalies. Spurred by this perspective, Avramov and Chordia (2006) conduct an analysis to determine whether conditional asset pricing models can explain the book-to-market ratio and firm size effect on expected returns, considering that they are perceived to be the most puzzling financial market anomalies. The same scholars also report results illustrating that conditional CAPM, where betas are permitted to differ with default spread, book-to-market ratio, and firm size, is unable to capture any of the anomalies mentioned above. Nonetheless, significant improvements are introduced by the Fama and French three factor model compared to the conditional CAPM. The Fama and French three-factor model's competitive edge is that it is able to explain both the book-to-market ratio and firm size effects. An argument advanced by Avramov and Chordia (2006) is the effect that the success of the conditional Fama and French model in capturing the size effects back risk-based size effect explanations. Suppose there is no connection between value effects and risk, then conditional forms of pricing models will not be able to capture such anomalies.

Fama and French (1992) aimed to test how systematic risk (β), firm size, price-to-earnings ratio, debt, and book-to-market ratio affect returns on NYSE, AMEX and NASDAQ-listed stocks. Their results show that on average equity returns, both company size and book-to-market absorb the apparent roles of leverage and E/P. A key publication on which a broadly multi-factorial model has been presented is Fama and French (1993). They implemented two additional factors, the size factor and the book-to-market factor, in the Capital Asset Pricing Model, thus introducing the Three Factors Model.

The model was developed to consider additional portfolios or components of systemic risk (Fama and French 1993). This contained the firm-size as a factor denoted to as 'small minus big' (SMB) factor, whereas a portfolio formed with low trading price shares and a separate portfolio formed with high market values securities. Next, the disparity between those two portfolios returns is calculated as a risk factor to decide if the scale of the company has an effect on the stock return. The authors have recommended the importance and inclusion of another risk factor to measure the effect of the valuation of the business on the book-to-market value indicated as the 'high minus low' (HML) factor. Grouping in a portfolio, stocks with a low book-to-market ratio values those are seen as rising equities. Whereas a separate portfolio holds equities with high values of a book-to-market ratio those are considered as value firms. The proclamation is that equity returns from investments in growing businesses are greater than that of performance companies can also be checked by integrating the relative returns of both portfolios into the formula.

Shefrin and Statman (1995) have demonstrated the importance of both size and market factors in determining returns in the stock market. Loughran (1997) tested the stock market for the time period from 1963 to 1995 and found that the book-to-market of small companies has the power to explain the returns achieved. Pontiff and Schall (1998) tested both the Dow Jones Industrial Average (DJIA) and Standard and Poor (S&P) indices for the period from 1926 to 1994.

Their results of the book-to-market ratio for the DJIA in the pre-1960 dataset were compared to the spreads of interest yields and dividend yields in the yield forecast, the book-to-market ratio showed that it has the ability to capture information that the other variables do not have. In the post-1960s, the S&P book-to-market ratio had weaker forecasting power than the pre-1960 DJIA sample. This indicates that the strength of a factor can differ from market to market and from a time period to another.

Maroney and Protopapadakis (2002) tested seven national markets confirming the results of Fama and French (1993) that there is a strong relationship between stock returns and the size of the two factors and book-to-market. Gaunt (2004) revealed that the three-factor model represents a significant improvement for the CAPM, and book-to-market plays a role in it when pricing assets. Bartholdy and Peare (2005) tested the three-factor model using a monthly five-year dataset and found that the model on average could explain about 5% of the differences in performance. Bello (2008) tested the Three-Factor Model by comparing it to the CAPM using an equity mutual fund with a sample of data sets from 1986 to 2006, with results that revealed that the multi-factorial model was able to improve quality of the predictions of the single-factor model.

Nartea et al. (2009) tested the three-factor model on the New Zealand market and find an improvement in the multi-factor model over the CAPM in the explanation of returns. Another attempt to test the three-factor model on the Turkish market by Eraslan (2013) shows that the model is powerful in its ability to explain portfolio returns. Sanusi and Ahmad (2016) take a different approach to test the three-factor model on individual Oil and Gas UK stocks, they conclude that all three factors used in the model are relevant in determining asset returns.
Lawrence et al. (2007) analysed the results comparing the original CAPM and the Fama-French Three-Factors Pricing Models along with other models using the Fama and French twenty-five portfolio results. The outcome of this analysis indicates that the Fama and French Three-Factors Model are more effective in describing equity returns than the initial CAPM and the other models. Sehgal and Balakrishnan (2013) tested the resiliency of Fama and French Three-Factors Model in the Indian stock market. They followed (Fama and French 1993) technique in particular in the development of portfolios. The results of the study suggest that Fama and the French Three-Factors Asset Pricing Model is excellent in the explanation of equity returns relative to the conventional CAPM.

Other studies find that the Fama-French Three Factors Asset Pricing Model is no longer an optimal model to be used; and they accuse it of an invalid inference as new research shows that the equity selected, and the time period of the data set can alter the models results (Koller et al. 2010; McKenzie and Partington 2014). Vo (2015) tested this argument in the Australian stock market. Vo (2015) used a data set from 2009 to 2014 using three different scenarios to consider the robustness of the estimates for the factor coefficients. Also, they used five different approaches of portfolios formations. The conclusion was that beta had the only significant coefficient in all the different testing scenarios and portfolios approaches. The other two factors presented very mixed results where the SMB was priced better than the HML.

Jin et al. (2015), tested anomaly effects in empirical asset pricing models. Among the models tested are the CAPM and the Fama and French Three factors model. They used a monthly U.S data sample from 1973 to 2009. The excess returns, size and book to market ratio data was collected from French's website data library. The market level of aggregate liquidity was collected from Pastor's website. In addition to the full sample, they used three subsamples from 1973 to 1982, 1984 to 1996 and 1997 to 2009 to examine changes in the models' characteristics and behaviour between the full sample and the subsamples. Jin et al. (2015) experimental outcomes indicate that book-to-market ratio and firm size significantly impact the portfolio excess returns for the full sample and two-thirds of the sub-samples of all pricing models being investigated. Specifically, the nonparametric component significantly differs from zero, implying that the created common factors are unable to capture the entire book-to-market ratio and size effects. The same researchers also report that there is robust proof that in the Fema and French three factors model, the anomaly effects are nonlinear for the full sample and two of the subsamples.

As Fama and French (2012) demonstrated, the regional variants of asset pricing models offer fair representations of local average portfolios returns constructed based on the equities value and size. The findings indicate that asset pricing is not synchronised across continents. In general, and especially for Europe, when compared with global models these models returns descriptions is much more clearer (Gregory et al. 2013). Although Fama and French (2012) are unclear on the likely explanations in such matter, theories they could have different macroeconomic exposures conditions in more open or smaller economies, different globalisation degrees of entities within nations, and different treatments in accounting for calculating book prices used to sort stocks by their book-to-market ratio (Gregory et al. 2013).

In the case of a regionalised models for asset pricing outperform globalised models, then, by default, the expectation is that models with a country-level basis to outperform regional-level models (Gregory et al. 2013). This comes in alignment with what (Grifn 2002) argues that the three-factor models on a country-specific basis describe returns of average stocks in a more enhanced way compared to globalised models or internationalised variations of the model. Thus, it indicates that cost-of-capital estimates, efficiency assessments and the analysis of risk when the Fama and French models are used they are best performed on a domestic level.

Author Name	Main Focus of study
Markowitz (1952); Sharp (1964); Lintner (1965); Mossin (1966)	The foundation and the development of the asset pricing theory and CAPM
Jensen et al. (1972); Levy (1983); Ferson and Jagannathan (1996); Perold (2004); Fama and French (2004); Bartholdy and Peare (2005); Goyal (2011); Hodnett and Hsieh (2012); Dalgin et al. (2012); Bilgin and Basti (2014); Schulmerich et al. (2015)	Explaining and applying CAPM
Douglas (1969); Black et al., (1972); Fama and MacBeth (1973); Roll (1977); Ang et al. (2010); Crotty, Epstein and Wolfson (2013); Guermat (2014);	Challenges in testing and applying CAPM
Jensen (1978); Ross (1977); Basu (1977); Banz (1980); Reinganum (1981); Jegadeesh (1990); Fama and French (1992); Fama and French (1993); Hawawini and Keim (1998); Frankfurter and McGoun (2001); Hundal, Eskola and Tuan (2019)	Anomalies in the CAPM
Kester et al. (1999); Truong et al. (2008); Pham et al. (2012); Bozec et al., (2014); Bozec et al. (2014); Khan (2016)	Evidence in support of the CAPM
Belesis, Sorros and Karagiorgos (2020)	Comparing the type of data to be used in testing CAPM
Pontif and Schall (1998); Bornholt (2013); Rojo-Suárez, Alonso-Conde and Ferrero-Pozo (2020)	Applying CAPM on full sample and subsamples.
Banz (1981); Stattman (1980); Roll (1981); Reinganum (1982); Fama and French (1992); Rosenberg et al. (1985); Shefrin and Statman (1995); Loughran (1997); Rouwenhorst (1999); Lewellen, (1999); Horowitz et al., (2000); Hou and Dijk (2008); Dijk (2011)	Evidence of other factors impacting returns
Chan et al. (1985); Chan and Chen (1991); Fama and French (1993);	Implementation of a multi factor asset pricing model
Maroney and Protopapadakis (2002); Gaunt (2004); Bartholdy and Peare (2005); Lawrence et al. (2007); Bello (2008); Nartea et al. (2009); Sehgal and Balakrishnan (2013); Eraslan (2013); Sanusi and Ahmad (2016)	Applications of the Fama and French three factors model
Berk et al. (1999); Avramov and Chordia (2006); Chou et al. (2010); Koller et al. (2010); McKenzie and Partington (2014); Vo (2015); Jin et al. (2015)	Anomalies in the Fama and French three factors model
Grifn (2002); Fama & French (2012); Gregory et al. (2013)	Examination of using local vs. global factors in testing the Fama and French three factors model
Basu (1977); Ball (1978)	Using CAPM to prove anomalies in the EMH

Table 2.2 Summary of literature on asset pricing models

2.3 The Cyclical Adjusted Price to Earnings Ratio

Many studies have attempted to test ratios in stock markets to predict market direction and help determine their investment strategy. In this review, the focus will be on studies building the Cycle Adjusted Price to Earnings (CAPE) ratio. An attempt to study asset values to determine if it is over or under priced, is the price to earnings ratio that relates market variables with the company's financial statements information. According to Campbell and Shiller (1998) a reported price-to-earnings ratio for just one year presents the stock situation only in that particular year. Using it in a forecast can result in an incorrect forecast due to external factors such as inflation that can affect the ratio. Hence, Graham, Dodd and Cottle (1934) pointed out how to introduce volatility and changes in the business cycle into the valuation of the (price/earnings) ratio by averaging five, seven, or ten-year earnings to look at valuation reports.

Basu (1977) has been among the earlier researchers who considered price-earnings ratio as an important metric about the relative value of equity securities. Over 1,200 manufacturing companies listed on the New York Stock Exchange (NYSE) (P/E) ratios were examined between September 1956 and August 1971. The portfolios of the firms being analysed were generated based on comparable (P/E) ratios and their risk-return relationship was contrasted for the stock market performance appraisal. Data analysis revealed that the (P/E) ratios can stand as a measure of potential investing success because of being undervalued relatively. Basu (1977) argued that stocks prices may not be efficient all the time and may be different from their intrinsic value and hence may cast a challenge to the EMH.

Shiller (1980), Campbell and Shiller (1987, 1988) and MacDonald (1994) all used present value models to explain the price of financial assets. As Campbell and Shiller (1987) have shown, the verification of the present value model for two variables follows linear stochastic processes that are stationary in the first differences rather than in the levels. As with Campbell and Shiller (1987), the two variables are co-integrated once the variables are stationary, which occurs when the present value model is true. Campbell and Shiller (1988) have indicated that future real dividends can be predicted using a long moving average of real earnings. In addition, they added that the ratio of an earnings variable to the current share price is a powerful predictor of stock return, particularly when the return is measured over several years. It was also observed that stock prices and returns are too volatile to agree with a simple present value model (Campbell and Shiller 1988).

MacDonald and Power (1995) presented a change to the present value share price model that explains share prices based on dividends and retention term. Furthermore, they demonstrated the existence of a unique co-integrating relationship between stock prices, dividends and retention term. Fama and French (1992) used the price to earnings ratio among other factors to determine expected stock returns. Additionally, Lakonishok et al. (1994) used earnings over price with other fundamental value measures to test whether the market is outperforming value-based strategies.

Campbell and Shiller (1988) used the concept of averaging earnings over many years to predict dividends. Their results show that real dividends can be predicted using a long moving average of real earnings. Also, when you take the ratio of these variable earnings to the stock price, you can predict the performance of the stock, especially when measuring returns over several years. Furthermore, they have shown that a simple present value model cannot match stock prices and returns because they are too volatile with the exception of annual returns.

Campbell and Shiller (1998) analysed several valuation ratios in an attempt to challenge the efficient market theory's claim that predicting the movement of stock prices cannot be obtained with any valuation model. They looked at a variety of ratio and tested their forecasting ability in predicting market volatility. The first ratio examined was the dividend yield ratio and the second was the price to earnings ratio. Their study sought to answer the question of whether the price to dividend ratio had a predictive ability for dividend movements under the efficient market hypothesis or to predict stock prices. The test results show that the dividend to price ratio was unable to predict future dividend growth.

However, it showed a strong tendency to predict future price changes. Their results also show that when the ratio is less than 3.4% the market dropped back to the ratio's average level, which then restored the ratio to the average. When plotted the price-to-earnings ratios of the US annual S&P 500 data, they found that the ratio moved between 8 and 20 with 14.2 as an average and their occasional outliers dropped to 6 and have risen to 26 the price to dividend ratio was between 3% and 7% with 4.73% averaging and occasional peaks reaching 10% and lows around 2%.

Since price is both the numerator of the price-to-earnings ratio and the denominator of the price-dividend ratio, increasing the price will cause the price-to-earnings ratio to rise and the price-to-dividend ratio to go down, both showing an opposite movement in direction between the two relationships. However, the results from Campbell and Shiller (1998) show that some peaks that appear in the price to earnings ratio will not necessarily manifest themselves in the dividend ratio. Graham and Dodd (1934) pointed out how to introduce volatility and changes in the business cycle into the valuation of the price to earnings ratio. In addition, they recommended averaging five, seven, or ten-year earnings to look at valuation reports.

After Campbell and Shiller (1998) used the levelling method implemented by Graham and Dodd (1934), real gains have been levelled over the past decade; then the smoothed P/E ratio was calculated, and the results revealed that the ratio moved in the same range as the normal P/E ratio fluctuated with the exception that the average was slightly higher at 15.3. However, the 1997 ratio hit a record high at 28. Their analysis showed that the predictability of future smoothed earnings growth, using the smoothed earnings-to price ratio, is very low and not statistically significant. But when the ratio was used to predict ten-year growth in stock prices, it showed a good forecast with a better fit compared to the price-dividend ratio.

The combined work of Campbell and Shiller (1988, 1998, 2001) and Shiller (2005) were the building blocks of the Cycle Adjusted Price Earnings (CAPE) ratio, which made an adjustment by averaging real earnings over ten years to develop the relationship. Many studies have criticised the (CAPE) ratio in several respects, such as Butler et al. (2012) who considered the CAPE measurement period to be too long and discussed the question of different measurement periods. However, Faber (2014) calculated the CAPE ratio for several markets and the results showed that between seven to ten years is a reasonable measurement period. Faber (2014) concluded that an investment return is highly dependent on the price paid for acquiring the asset.

Tower (2012) used a different approach in calculating CAPE using a trend real earnings in calculating the P/E. That is by regressing the natural log of real earnings on time and taking antilogs of the calculated values. The data set used in testing this approach was U.S market dataset starting from December 1871 downloaded from Shiller's website data library. Tower's findings show that the new method of calculating CAPE produced a better ratio than the original CAPE ratio. However, his comparison results show that the prediction of real wealth standard error of estimate falls by 0.19% when using the improved CAPE ratio, which is not a major significant difference between the two ratios.

Sturgess (2012) compared Tobin's q (QR), the Equitisation Ratio (ER) and CAPE's ability to identify if equities are significantly undervalued, which then offers an opportunity to provide rising future returns or if they are overvalued or fairly valued. For the CAPE ratio, the S&P 500 dataset available on Shiller's website data library was used covering the period from 1952 to 2010. The result shows that all three ratios move together very closely with a statistically significant correlation coefficient over 0.9. Additionally, they are providing similar indications of the market's value. Yet Sturgess points out that improvements in the quality of accounting data in particular the reported earnings make it a hurdle to compare recent CAPE with its historical values.

Furthermore, studies such as Siegel (2016) and the comments of Liz Sonders reported by Faber (2014) argue that accounting principles change from time to time, which affects the calculation of earnings and consequently, CAPE fails to adapt to such changes. Therefore, Siegel (2016) has suggested a different relationship that might overcome accounting issues. However, when comparing the result with the CAPE ratio, the variation in the results is minimal, which makes the CAPE still a reliable measure.

Feldman, Jung and Klein (2015) examined active investment strategies against consistently simply holding the S&P 500, which is a benchmark passive investment strategy. Their idea is to compare between the use of a fundamental-based indicator, the CAPE ratio, U.S. Treasury yield curve, 200-day S&P 500 simple moving average and S&P earnings yield versus Treasury yield as signalling tools. Their strategy is to fully invest in the S&P 500 and whenever the indicator drops three months in a row the investment is switched to the three-month T-bills and when the indicator increases three months in a row the investment is switched back to the S&P 500. They used a monthly sample period from 1970 to 2012.

Feldman et al. (2015) technique with the CAPE ratio is to calculate the ratio (R) of the current CAPE to the long-term average CAPE and divide the valuation ratio's signals into five categories. A significantly overvalued when R is more than or equal to 150%, modestly overvalued when R is between 117% and 150%, fairly valued when R is between 83% and 117, modestly undervalued when R is between 67% and 83% and significantly undervalued when R is below 67%. Their strategy then is to invest 100% in T-bills when the signal is significantly overvalued. In a modestly overvalued the investment will be 25% in the S&P 500 and 75% in the T-bills. In a fairly valued it will 50% in both the S&P 500 and the T-bills. In a modestly undervalued situation, the investment is 75% S&P 500 and 25% T-bills. Finally, in a significantly undervalued situation, the investment is 100% in the S&P 500.

Their results show that if a hypothetical $100 is invested with this strategy using the CAPE indicator it would have generated around 8% annualized return over the 43 years period underperforming the buy and hold passive investment strategy by 1.97%. Moreover, when compared to the other indicators CAPE had the lowest return. When they annualized the returns by decades in the first decade, the 70's, using the CAPE indicator made a 7.14%

return. In the 80's it made a 16.19% return, which was a time period where the market was booming. In the '90s the annualized return dropped to 6.55% as the market was approaching the dot.com bubble and was in an overvalued period. In the first ten years of the 2000s, the return was 3.14% experiencing a major drop. However, it should be noted that two major market corrections occurred in the early 2000s which rendered its effect on the investment returns in that time period. They concluded that CAPE's over valuation or undervalation signals maybe misleading.

Using a different approach Keimling (2016), examined the CAPE ratio long-term returns forecasting potential in 17 MSCI country indexes, which includes the UK market. Moreover, Keimling examines a CAPE adjusted for pay-out ratios and the common fundamental indicators, the classic price-to-book ratio, price-to-earnings ratio, price-to-cash-flow ratio and the dividend yield. The data set runs from December 1979 to 2015. The conclusion was that the adjusted CAPE did not improve CAPE's prediction. Moreover, among all ratios, only CAPE and the price-to-book ratio were able to forecast the long-term equity market potential. Based on the finding's investors are better off investing in European markets than the U.S. market as the potential expected gains are higher.

Philips and Ural (2016) aimed to tests the existence of a theoretical relationship between CAPE and equities return, whether average earnings or other profitability measures should be used in constructing the ratio and how CAPE should be evaluated and used. Using the CAPE data set available on Shiller's website data library for the S&P 500 they tested the market from 1925 to 2015. They concluded by recommending that CAPE should be used to forecast nominal returns, not real returns. Also, they found that using the weighted past earnings by revenues or using the GDP instead of the CPI will improve the ratio. Additionally, they recommend using CAPE to evaluate equities returns in relation to those of other asset classes.

Asness, Ilmanen and Maloney (2017) tested the possibility of outperforming a passive buy-and-hold investment strategy. They used CAPE to implement the following timing signal 100%+(trimmed CAPE – median CAPE) / (95^{th} – 5^{th} percentile range), the cap of the signal will be at 150% and the floor at 50%. Trimming at the 95 and 5^{th} percentiles reduces the compressing effects of extreme values. The study was performed on a U.S data sample from 1900 to 2015. The CAPE data was sourced from Shiller's data library and the market returns from Datastream. According to their conclusions, it finds that while contrarian market timing has outperformed buy-and-hold over the past 115 years, it has underperformed in the latter half of the sample (a very long time!) and generally looks weaker than many might expect.

According to Arnott et al. (2018), it makes no sense to ignore the Cyclically Adjustable Price-to-Earnings (CAPE) ratio, as it is a powerful tool for predicting stock market returns in both the US and international markets. However, in their study, they disagree with the long historical static average CAPE value of 16.6 as the equilibrium valuation level for today's market, which is similar to Siegel (2016) observation. Instead, they suggest a high balance of the CAPE ratio supported by rising earnings growth rates that come from the power of brands, political policies and monopolies. However, those factories, as they explained, are tied to past earnings but not as informative for future growth rates. Therefore, they support the high balance of the CAPE ratio with other macroeconomic factors such as falling real interest rates and low inflation rates and movements in GDP.

Authers (2018) confirms as previous studies that the CAPE ratio has a valuable signal of market value but fails to predict the peak or turning point. According to Authers (2018), the concept of an average upward sloping equilibrium CAPE ratio is quite tempting, but in practice, it is not as simple as theoretically. For example, aftermarket earnings fully recovered following the 2008 financial crisis in June 2010, the CAPE was at 33.2 using the Shiller method and 27.3 as Arnott et al. (2018) suggest; in both cases, CAPE was above the trend line implemented by Arnott's.

Dimitrov and Jain (2018), attempt to test if CAPE is evidence of market inefficiency. They attempt to shed light on the market efficiency debate by presenting two sets of analyses. They first note that in efficient markets, investors will not necessarily be assisted by knowing CAPE in earning better returns in the future by offloading or acquiring risk-free assets at a time of either high or low CAPE. The second analysis stipulates that in efficient markets, CAPE should be linked to the stock market general risk. Through analysis of the link between CAPE and future VAR, they tested these hypotheses.

They concluded on average, future returns on ten-year stock are higher compared to future U.S. Treasury's 10-year returns even when CAPE is in its ninth decile. Therefore, the results are mainly in support with market efficiency. Secondly, in support with the trade-off on risk-return, these scholars discover that there is a negative relationship between CAPE and future volatility in the stock market. They also arrived at the conclusion that CAPE levels are not a reflection of market inefficiency. Moreover, they arrive at the conclusion that there is a negative connection with the stock returns' 10-year volatility. Additionally, they found a positive connection between volatility and future stock returns. Therefore, risk, based on volatility, could be viewed as an elucidation for stock returns patterns based on CAPE. Generally, CAPE's ability to predict future stock market returns is in keeping with a positive risk and returns relationship.

Author Name	Main Focus of study
Basu (1977);	The use of the P/E ratio in measuring investing performance.
Shiller (1980); Campbell and Shiller (1987); Campbell and Shiller (1988); MacDonald (1994); MacDonald and Power (1995)	The use of present value models to explain assets prices
Campbell and Shiller (1988); Fama and French (1992); Lakonishok et al. (1994);	Test of different models to determine expected stock returns
Graham, Dodd and Cottle (1934); Campbell and Shiller (1998);	Testing the usefulness of smoothing the P/E by averaging it over several years
Campbell and Shiller (1988); Campbell and Shiller (1998); Campbell and Shiller (2001); Shiller (2005	Studies that formed the CAPE ratio
Butler et al. (2012); Faber (2014); Keimling (2016); Arnott et al. (2018); Authers (2018)	Testing and applying the CAPE ratio in different markets
Tower (2012); Sturgess (2012); Philips and Ural (2016)	Testing different approaches in calculating the CAPE ratio
Siegel (2016)	Presenting anomalies of the CAPE ratio
Feldman, Jung and Klein (2015); Asness, Ilmanen and Maloney (2017)	Examining the use of CAPE in investment strategies
Dimitrov and Jain (2018)	Testing if CAPE is evidence of market inefficiency

Table 2.3 Summary of CAPE literature

2.4 Gaps in Current Literature

As presented by the previous literature prior research has focused on studying the CAPE ratio in five areas. First, it was on examining the CAPE ability to forecast future market returns (Tower 2012; Keimling 2016; Angelini et al 2018; Tolani et al. 2018; Shelley et al. 2020). Second, studies focused on enhancing the CAPE ratio like (Siegel 2016; Philips and Ural 2016; Philips and Kobor 2020). Third, they used CAPE as a sentiment indicator for investment decisions (Feldman et al. 2015; Asness et al. 2017). Forth, they used CAPE to examine and challenge the EMH (Dimitrov and Jain 2018). Fifth, comparing CAPE with other indicators (Sturgess 2012; Tolani et al. 2018;). Studies that looked in the asset pricing models used it to evaluate securities or to determine what factors affect returns. Additionally, Prior research has focused on studying asset pricing models on individual stocks, sectors or portfolios formed from the entire market for long time period and subsamples based on historical events, such as the post-World War 1 and 2 (Bornholt 2013; Foye et al. 2013; Vo 2015; Rojo-Suárez et al. 2020). Yet, to the best of the researcher's knowledge, there is not enough literature that has analysed the asset pricing characteristics and behaviours in the different phases of the CAPE ratio in the London Stock Exchange with a dataset that covers a reach sample period of a stock market boom (2001–2007), two major economic recession periods (2000-2001) and (2008– 2009) and an economic stability period (2010–2017).

2.5 Research Objectives and Hypothesis Development

This review of the existing literature is helpful for this study to set the following objectives in an attempt to further study the behaviour of stock returns using these asset pricing models. To study the CAPM in subsamples representing different market situations (overpriced, fairly priced and under priced market) to examine changes in its characteristics and behaviour from one period to the other and compare it to the full dataset and understand whether the model performs better in a long-term study or in the short-term. To study the Fama and French three factors model in subsamples representing different market situations (overpriced, fairly priced and under priced market) to examine changes in its characteristics and behaviour from one period to the other and compare it with the full data set and to understand whether the model performs better in a long-term study or in short time periods.

Previous studies (Tower 2012; Keimling 2016; Angelini et al 2018; Tolani et al. 2018; Shelley et al. 2020) have found usefulness in the CAPE ratio market valuation, and they forecast future returns based on the ratio's level. Moreover, other studies (Feldman et al. 2015; Asness et al. 2017) establish a use of the CAPE ratio as an investment indicator. In the light of this literature review, the following null hypothesis have been identified and shall be tested and evaluated in this thesis.

1. H_0: The CAPE ratio cannot be used as a signalling tool to classify the market as under priced/fairly priced /overpriced

   H_1: The CAPE ratio can be used as a signalling tool to classify the market as under priced / fairly priced / overpriced

Studies on asset pricing models show the widely spread use of the CAPM (Kester and Chang, 1999; Truong et al. 2008; Pham et al. 2012; Bozec et al., 2014; Khan, 2016). Despite the literature criticising it (Jensen, 1978; Ross, 1977; Basu, 1977; Banz, 1980; Reinganum, 1981; Jegadeesh, 1990; Fama and French, 1992; Fama and French, 1993; Hawawini and Keim, 1998; Frankfurter and McGoun, 2001; Hundal, Eskola and Tuan, 2019), which indicating the usefulness of this model. Also, studies on multi asset pricing models showed support for the Fama and French three factors model globally and in the UK market (Maroney and Protopapadakis, 2002; Gaunt, 2004; Bartholdy and Peare, 2005; Lawrence et al. 2007; Bello

2008; Nartea et al. 2009; Sehgal and Balakrishnan 2013; Eraslan 2013; Sanusi and Ahmad 2016; Grifn 2002; Fama and French 2012; Gregory et al. 2013). Furthermore, few studies (Pontif and Schall, 1998; Bornholt, 2013; Rojo-Suárez, Alonso-Conde and Ferrero-Pozo, 2020) found that applying asset pricing models on subsamples showed some improvement and indicated changes in those model's results and characteristics from one period to the other. Based on those findings in the literature the following hypothesis are formed:

2. H_0: There is no change in the performance of the CAPM under different time periods within this study.

   H_1: The performance of the CAPM is not similar in different time periods under study.

3. H_0: There is no change in the performance of the Fama and French Three Factors model under different time periods within this study.

   H_1: The performance of the Fama and French Three Factors model is not similar in different subperiods within this study.

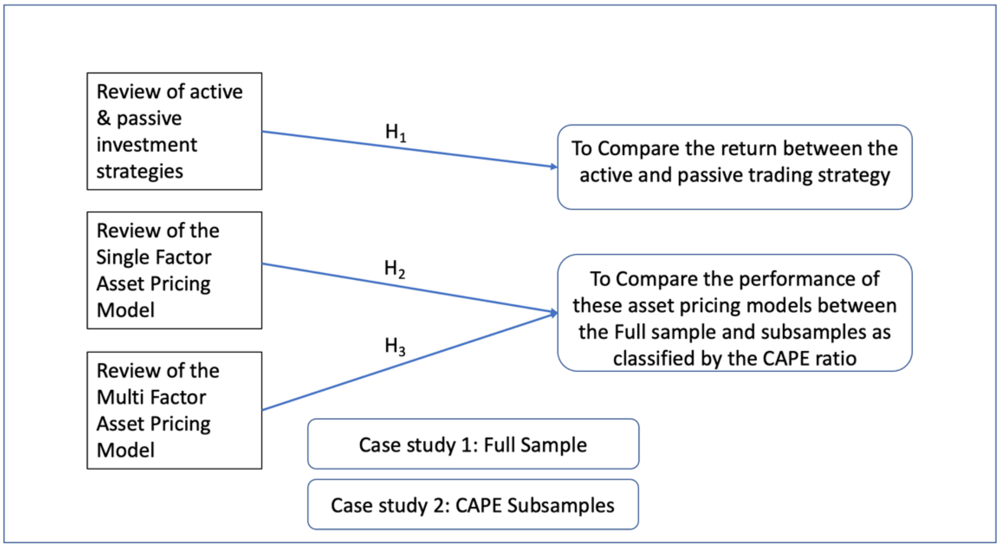

Figure 2.2 The Conceptual Framework of the Study

2.6 Conclusion

This chapter covered the literature on the EMH introducing the market efficiency theory, studies that criticised it, the anomalies that cannot be explained by the theory and its application in stock markets. Moreover, asset pricing models were introduced along with its assumptions, different methods for using it and anomalies that challenge it. The last part of the literature focused on the CAPE ratio showing different studies that debated its application and its strength and weaknesses. Afterwards, the gaps in the literature that this study intends to address is presented. Next, the research objectives and hypothesis to be tested have been extracted from the literature.

In conclusion, in spite of the widespread Fama and French three factors model, CAPM, and Efficient Market Hypothesis models, many anomalies and challenges that these models cannot fully explain still exist. However, those who support Efficient Market Hypothesis advance the view that the noted anomalies result from the incorrect risk measurement or statistical errors. Therefore, they advance the view that the presence of the identified anomalies does not necessarily call for an alternative paradigm to replace the Efficient Market Hypothesis.

The review of literature on Efficient Market Hypothesis highlights the grey areas in the analysis of asset returns under different market conditions which may pose a challenge to the validity of EMH. This study will extend this debate by providing more evidence on the validity of the EMH by examining the changes in the asset prices characteristics in different market valuation levels. The cyclically adjusted price to earnings (CAPE) ratio will the tool used to identify the subsamples of an under priced, fairly priced and overpriced market, which are the subsamples where the asset pricing models will be tested.

The next chapter will focus on presenting the methodology used in this study. It will show how the study intends to use the sample data to test the hypothesis and answer the research questions. Hence, this will attempt to fill the gap identified in the literature and hopefully contributing new knowledge in this field of financial markets.

Chapter 3 - The Research Methodology

The main aim of this chapter is to provide a detailed description of the research methodology used in this study. In order to achieve this, it will focus on explaining the methodological process adopted to achieve the aim and objectives of the research (as described in chapter 1). This chapter has been divided into six sections. The first section focuses on the review of the relevant research philosophies from the social sciences point of view. The second section discusses the research design. The third section describes the theoretical framework of the study. The fourth section discusses the population and sampling issues. The fifth section presents the data analysis techniques and analytical framework, and the last section summarizes the discussion in the form of concluding remarks.

3.1 Research Philosophy

Johnson and Clark (2006) suggest that in a research study, it is imperative that the researcher understands the theoretical approach of the research so that the objectives of the research are achieved, and as a result it contributes positively to the literature. According to Rolfe (2013), the scientific method of the social sciences originated in 1830 when the French philosopher Auguste Comte applied it for the first time. Six years prior to Comte, William Thompson had already coined the term social science to refer to his endeavours as a positive science of society or positivism (Rolfe 2013). As argued by Comte, there are three stages that human knowledge goes through: theological, philosophical, and scientific (Rolfe 2013). In the first two phases, the researcher mainly conducts research in the direction of the inner nature of beings and to the absolute knowledge of the reasons for the beginning and end of all the phenomena it perceives (Rolfe 2013). As the focus of this study is interpreting financial data, it would be more inclined towards the third approach, the scientific approach.

According to Thornhill et al., (2009), the research philosophy is based on the development of knowledge and the nature of knowledge in a specific field. It does not mean that a researcher must establish a new theory altogether rather adding perspective to a solution of an existing problem can also be considered as a new development of knowledge. Furthermore, the way in which a researcher views the world stems from concrete important assumptions adopted by the chosen research philosophy. Consequently, awareness of the philosophical commitments undertaken by researchers in choosing the research strategy for research in the field of business and management is necessary. It is necessary for a researcher to know how to defend and reflect on their choice of philosophy in relation to other choices that could have been adopted (Thornhill et al. 2009). The two main points of view for thinking about the philosophy of research as a researcher in social sciences are represented by ontology and epistemology.

The focus of the ontological research philosophy is on the nature of reality, life and characteristics associated with existing entities (Saunders et al., 2012). As Bryman and Bell (2007) underline, the fulcrum of ontological considerations is whether social entities are objective entities, thus possessing an existence outside the social actors, or whether they are to be considered subjectivist social realities to the extent that they are developed from the perceptions and actions of social actors. Objectivism and subjectivism are the two aspects of ontology that social science researchers are dedicated to address (Thornhill et al., 2009). Objectivism is an ontological research position which implies that social entities exist separately from social actors (Bryman and Bell 2007). For example, human beings in every society behave in accordance with the social culture to be seen as good individuals. On the other hand, subjectivism is an ontological research position according to which the perceptions of social actors and the resulting actions give rise to social phenomena (Thornhill et al. 2009). This research position presents social actors as external realities that have no role in the formation of organization and culture (Dent et al. 2018).

The epistemological research focus is on the acceptable knowledge (Thornhill et al., 2009). According to Bryman and Bell (2007), a particular problem in epistemology is whether or not the principles, procedures and ethos used in the natural sciences can be applied to the social sciences. The epistemological position that advocates the importance of learning from the natural sciences in favour of the social sciences is known as positivism. The other epistemological philosophical position that is similar to positivism in assuming a scientific methodology for the development of knowledge is realism with the caveat that the truth is what the logics show us as reality, which means that objects have an existence independent of the human mind. Conversely, interpretivism is an approach that criticizes the use of scientific models in social studies.

The last social science philosophical approach is Axiology in which value judgments are studied (Thornhill et al., 2009). This is a central constitutive sphere in the subject of philosophy. It mainly focuses on the beginnings, construction, and functions of values, their perception and grasp, and value systems' dynamics. It is a study of analysis of values leading into ethics. The role played by researchers' values is of great importance for research results to be credible at all stages of the research process. Moreover, the researchers' values are demonstrated at all stages of a research process. After all, it is impossible for an individual to completely free themselves of their experiences and value, there must be some predetermined bias and values (Ma, 2012).

The axiological, epistemological, and ontological positions for pragmatism are conceptualized such that they combine qualitative and quantitative paradigms as integrative and non-conflicting philosophies. The reality cycle is the ontological posture founded on the assumption that only one reality exists in a specific setting at a definite point of time and the manifold discernments of this reality is with the researcher. The epistemological stance is more double-faced knowledge, suggesting that any kind of knowledge can be perceived as observable or unobservable depending on the perception of the researcher. The necessary axiological posture or bias principle allows the researcher to achieve the objectives of their research.

This study is adopting the 'Positivism' research philosophy. The study's nature involves an examination of whether observable variables such as changes in asset prices are generated based on formulated hypotheses and theories. So, it will follow a deductive approach using secondary data. The advantages of using secondary data are the reliability of the data sources like "Datastream" and the low cost of collecting the data as compared to primary data. Thus, it is intended to undertake testing of hypotheses and applicability of theories developed by different prominent scholars in justifying the behaviour of asset returns. The objective is to verify and provide sufficient information to investors and other stakeholders about how to utilise the existing theories in their investing and trading decisions. In addition, the philosophical ethics and commitment are adhered to in respect of the adopted positivism approach by upholding the independence and objectivity of the collected data and the applied statistical tools for data analysis. The results will be presented in detail to make interpretations objectively and generalize the findings of the study.

3.2 Research Design

This section explains in detail the various econometric tests and methods which are used in examining the dataset in this research such as the CAPE ratio, the CAPM, and the Fama-French three factor model. In accordance with the adopted research philosophies and the nature of the research problem, a quantitative research method has been employed. This would lead to presenting a map for answering the research questions and testing the research hypothesis in the process. This method is comparable to that of an experimental research study utilizing statistical tools for testing whether the underlined hypotheses are accepted or rejected by measuring its significance.

The Cyclically Adjusted Price to Earnings (CAPE) ratio was applied to the dataset to identify the time periods where the market was overpriced, fairly priced and under priced. Next, an active investment strategy based on the CAPE ratio signals was tested on the sample and compared to a passive investment strategy to examine the effectiveness of using the ratio as a tool for trading in stocks. Furthermore, the results of the investment strategy were used to test the validity of the Efficient Market Hypothesis that markets are efficient all time and it is not possible to achieve a return higher than the market return. The last part was to identify time periods where the CAPE ratio was signalling an overpriced, fairly priced and under priced periods in the dataset. Those three periods were selected as subsamples for the study.

The Capital Asset Pricing Model (CAPM) was employed in the study to test if the market factor alone is enough to explain all the variation in stock returns. Additionally, the test compares the changes in the model's characteristics and behaviour from one subsample to the other. Moreover, the model is used to determine whether the characteristics and changes in market sentiments can challenge the consistency of CAPE ratio and the performance of the CAPM model. Stock portfolios were constructed on the bases of the market factor and examined in each one of the three subsamples besides being examined on the full dataset.

The Fama and French Three Factors Model would be used to examine the validity of the size and value factor in the dataset and to determine how well can these factors explain the variation in stock returns. Also, as in the CAPM approach, portfolios are formed and examined on the full dataset and in the three subsamples. The main examination was to test the consistency of the Fama and French Three Factors Model to determine any changes in the behaviour and characteristics of the three factors.

3.3 Theoretical Framework

The theoretical framework adopted in this research is based on the three main hypotheses of the study. The hypotheses are formulated to test the CAPE ratio valuation of the market and the usefulness of the ratio in an investment strategy. Furthermore, the hypotheses will test the performance and characteristics of the asset pricing models in the subsamples formulated on the bases of the CAPE ratio levels of market valuation.

3.3.1 Efficient Market Hypothesis – Fama (1970)

This hypothesis posits that if prices are a full reflection of all available information; then, financial markets are efficient (Fama, 1970). The ideas expressed by Fama (1970) are an attempt to improve the work done by Roberts (1967). This improvement is accomplished by doing a hypothetical test and then classifying the market efficiency hypothesis into the categories: strong, semi-strong, and weak. The basis of this classification is the kind of available information where in an efficient market that is weak-form prices are expected to be a reflection of all information available to the public regarding price movement. On the other hand, when the efficient market is of a semi-strong form, it reflects all information available to the public, and if the efficient market is a strong form, it reflects both the private and public information available. This represents what could be perceived as another revolution in finance characterised by scholars trying to evaluate the Efficient Market Hypothesis validity in different ways.

In achieving the research objective, the Cyclically Adjusted Price to Earnings (CAPE) ratio implemented by Campbell and Shiller (1988, 1998) will be tested in an investment strategy to examine the possibility of outperforming the market return and exploring the assumption of the Efficient Market Hypothesis that markets are efficient all the time. Also, the asset pricing models are used in subsamples built on the bases of the CAPE ratio signals to test if there are any changes in the performance of these asset pricing models.

3.3.2 Capital Asset Pricing Model (CAPM)

Capital asset pricing is a conceptual technique for pricing assets. The model was developed by several scholars, including Mossin (1966), Lintner (1965), and Sharpe (1964), from Harry Markowitz's portfolio theory. Over time, the model came to prominence in regards to defining the required rate of return for an asset. Based on the model, a specific asserts expected return rate is a function of the market risk premium and the risk-free rate of return. A lot of models being used today use the fundamentals of CAPM either as a supplement or in a manner that seeks to overcome its weaknesses. This study will test the risk factor as documented in the capital asset pricing model.

3.3.3 Fama and French (1993)'s Three Factor Asset Pricing Model

Fema and French (1993) proposed enhancements to the single factor models such as the CAPM. They accomplish this through integrating value (book-to-market ratios) and firm's size (based on market capitalisation), founded on the presumption that high growth stocks and big size stocks are outperformed by the small value and small size stocks in the market. This study will formulate and test these factors for statistical significance.

3.4 Population and Sample

The study distinguishes between target population, study population and sample. The target population is the entire group on which the study aims to draw its inferences. All the developed stock markets are the target population of the study. Unfortunately, the entire elements of the target population cannot be assessed contemporaneously. In order to overcome that barrier and conform to the intentions of the research, a study population was extracted. The study population is the market on which variables are assessable and inferences can be made rightfully. The focus of this study will be on the London Stock Exchange (LSE).

The most appropriate frequency of data used in the asset price modelling literature is monthly prices and returns such as (Campbell and Shiller 1988; Sturgess 2012; Rotblut 2013; Feldman, Jung and Klein 2015; Shiller 2015; Keimling 2016; Asness, Ilmanen and Maloney 2017; Waser 2021; Bornholt 2013; Eraslan 2013; Gregory, Tharyan and Christidis 2013; Shaharuddin, Lau and Ahmad 2017; Lambert, Fays and Hübner 2020; Li et al. 2020). Thus, monthly stock price data for the London Stock Exchange has been used in the study for the period December (1998) to December (2017) making 229 observations, which is the longest period with all the study's needed variables available. This time period covers a period of a recession (2000 – 2001) the Dot.com bubble and (2008– 2009) the subprime mortgage securities related recession, which are the two recent major financial crises that affected financial markets globally. Also, it covers a stock market boom (2001–2007) following the Dot.Com crises and an economic stability period (2010–2017) following the subprime mortgage crisis.

There are different views on the number of cases needed as a sample size to be able to generalise results specially when using a regression (Pallant 2016). According to Hair et al. (2018) the rule is five observation per independent variable. Stevens and Pituch (2016) recommendation is a minimum of 15 cases per independent variable in social science studies. Tabachnick and Fidell (2013) provided a formula to determine the sample size, which is N > 50 + 8 (number of independent variables). In the case of this study the lowest sample size is 15 monthly observations, which is in line with the recommendations of (Hair et al. 2018). Furthermore, the study is constrained by the CAPE ratio levels, which forces the sample size for each subsample based.

The CAPE ratio of the FTSE 100 index for the period of the study have been used to examine the market valuation levels and identify the subsamples. Additionally, the betas for the LSE stocks for the period of the study has been used to build the stock portfolios for the CAPM tests. The market, size, and value factors for the period of the study are used for the Fama and French Three Factors Model test.

The FTSE All-Share index data and the stock prices of all companies included in FTSE All Share index were collected from the DataStream database available in the Aberdeen Business School. The CAPE ratio data for the FTSE 100 index were obtained from Siblis Research Ltd as the P/E and EPS for the index available on DataStream do not cover the entire period of the study. The market factors attributed to size and value factors were downloaded from the Exeter Business School website data library. It provides UK specific data on the risk factors used in multifactor asset pricing models.

The variables used in the study are:

1. The stock prices of FTSE All-Share index companies,
2. The FTSE All-Share index returns,
3. The FTSE 100 index returns,
4. The Cyclically Adjusted Price to Earnings (CAPE) ratio for the FTSE 100 index,
5. The betas of the companies of the FTSE All-Share index,
6. Market capitalisation, size premiums and value premiums.

3.5 Data Analysis Techniques

This section of the chapter explains the analytical techniques used and analytical framework adopted. The basic analysis process adopted in the study includes a graph of the CAPE ratio for the entire sample, a chronological table of all dates of financial crises included in the sample and the descriptive statistics of the maximum, minimum and average for each period associated with a given period of financial crisis and for the entire sample. The advance analysis includes ordinary least squared (OLS) regression modelling, which is a standard approach that measures the deviations and hence is effective in estimation (Allen,2017). Additionally, the research uses Durbin-Watson values (see Ali,1987) to measure and analyse autocorrelations in regressions residuals.

Once the data is sorted, a descriptive statistic of the entire data sample is presented in the study. In addition, a detailed table of all portfolios included in the study is added and a regression test is performed for each portfolio to produce the beta of the portfolio used in the CAPM analysis. Chapter 6 examines the performance of stock (equity) portfolios under the CAPE signals using the Fama-French three factor model and the relevant statistical tools are presented. The regression test in each portfolio produces the coefficients for each factor to be used in the evaluation of the performance of the Fama-French three factor model.

The index prices are used to diagrammatically compare the movements in the CAPE ratio's during the sample period. Firm's beta values were used to create the beta portfolios used in the study. Firm's stock prices were used to calculate the firms returns to be used in the Capital Asset Pricing Model (CAPM).

The primary objective of this research is to test the validity and interrelationship of Cyclically Adjusted Price to Earnings (CAPE) ratio signals in different ways. Initially the CAPE ratio is used to categorize the data sample into the three different segments as overpriced, under priced, and fairly priced. This is followed by analysis where historical events affecting the London Stock Exchange are identified to observe the impact of CAPE signal before, during and after the event. Subsequently, the Capital Asset Pricing Model (CAPM) is applied to analyse whether the portfolio returns are in line with the forecasts of this model during the different subsample periods under consideration. Consequently, the Fama-French three factor model will be used on different portfolios and tested in a similar way as in the CAPM.

Initially, the analysis requires deriving the Cyclical Adjusted Price to Earning (CAPE) ratio, which is a price-to-earnings ratio over a ten-year period adjusted for inflation and which is measured over the entire time period of the study. Next, every time period of a market above, below and with a fair price is noted. Thereafter, historical market events such as the 'dot com bubble' and the 'subprime mortgage crash' are considered for further analysis of the CAPE's performance before, during and after such events. Time periods are crucial as the behaviour of the market around them are studied to determine the usefulness of the CAPE ratio in these time periods and to perceive whether investors can use the ratio as a signal for market trends and for investment decisions, since the ultimate objective of this study is to examine the level and nature of market efficiency in the context of the signals obtained from the CAPE report.

3.5.1 The Regression Model

Fahrmeir et al. (2013) explains that Regression Models are used to identify the unknown link between a dependent variable and one or more independent variable(s) and examine whiter or not the independent variable(s) influenced the dependent variable. When the dependency between the variables is identified the model can then predict the dependent variable's value.

Representing the model graphically the variables are plotted on a chart with the dependent variable (Y) on the y-axis and the independent variable (X) on the x-axis. When the independent variable is equal to zero Y = α which will intercept the y-axis. To show the best explanation between the Y and X relationship a line through the middle of all the plots is drawn, which is known as the regression line.

The general form of each type of regression is:

- Simple linear regression: $Y = \alpha + \beta X + \varepsilon$
- Multiple linear regression: $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_t X_t + \varepsilon$

Where:

- Y = the dependent variable.
- X = the independent variable(s).
- α = the intercept, which is the point where the regression line crosses the y-axis determining the line’s distance to the origin along the y-axis.
- β = the slope, which determines X’s influence on Y the flatter it is the less affect X has on Y.
- ε = the regression residual (error term), which represents the difference between the actual Y and the estimated Y.

A simple linear regression is used when there is only one independent variable like the case of the CAPM. The multiple linear regression is used when there is more than one independent variable such as the Fama and French Three Factors Model where it has three independent variables. As in reality predictions are never perfect, thus an error term explains the certainty of the formula.

To assess the fitness of the regression line and measure how good the regression model the goodness of fit R^2 is used (McQuitty 2018). It is a statistical indicator that shows the percentage of the dependent variable explained by the independent variable (Cleff 2019). With more variables added to the regression model a case of overparameterization may occur, which is using too many independent variables in a regression; so an adjusted R^2 is used to evaluate the added variables and samples to the regression model (Cleff 2019).

Logically speaking the higher the R^2 the better the significance of regression results. However, depending on the nature of the study a low R^2 may indicate a good model and a high one not necessarily means a good fit regression (Frost 2017). For example, when studying humans, it is difficult to predict their behaviour and most likely the R^2 value will be less than 50%. As long as the independent variables are statistically significant the regression is a good fit (Hair et al. 2018). On the other hand, a high R^2 is not always good. In a case where the residuals are not randomly scattered the regression may have a high R^2 but the model is a bad fit (Frost

2017). Therefore, it is important to examine the residuals and the corelation between variables and not only relay on the R^2.

According to Wendler and Gröttrup (2021), another indicator of a good fit for a regression model is the Gaussian distribution of the error, which is a linear regression requirement. Examining the shape of the residuals histogram if it is approximately in a Gaussian density shape it is considered a linear structure and said to follow the Gaussian law. Also, a p-p plot can be used to examine the normal distribution. The closer the observations are to the diagonal line the close the model is to a normal distribution.

In accordance to Wendler and Gröttrup (2021), an F-test is two variances ratio. The variances are a measure of how the scattered plots are far from the mean. In a regression it assesses multiple coefficients instantaneously. The value should be at least 3.95 to be significant and reject the null hypothesis that the fit of the intercept only model and the model tested are equal.

As explained by Cleff (2019), residuals should be serially independent and no autocorrelation between them exists. According to (MacKinnon 2018), the Durbin-Watson provides a test of wither or not the residuals in the dataset are serially independent. The level of the autocorrelation is considered low when it is around 2. When it is closer to 0 the autocorrelation is positive, and a negative outcome is closer to 4. Testing historical prices for autocorrelation is critical to determine if a price change is just a pattern or the result of the previous price. Therefore, the (DW) test has been applied to all portfolios in the full sample and the three subsamples in both the CAPM and the Fama and French three factors model tests.

Moreover Cleff (2019) highlighted that when a regression has more than one independent variable the relationship between those independent variables needs to be tested to make sure they are not associated to each other. As defined by (Wendler and Gröttrup 2021), the Pearson Correlation expresses the direction and strength of the linear relationship between two variables. The range of the correlation coefficient is from -1 to 1. Whenever the coefficient is closer to 0 it indicates the absence of a correlation. Whereas a -1 represents a negative correlation and +1 is a positive correlation. The test is used in the study to measure if the three factors (independent variables) in the Fama and French three factors model are correlated to each other.

Additionally, a multicollinearity test is needed as it is impossible for a regression coefficient to be determine if it exists between the variables (Cleff 2019). According to (Hair et al. 2018), a variance inflation factors (VIF) is used to examine the multicollinearity. Every independent variable goes through an auxiliary regression; where one independent variable is used as a dependent variable and the other remain as independent variables. The larger the R^2 of the auxiliary regression is the stronger the association is between the independent variables. The VIF is then calculated using the following equation:

VIF = 1/1-R^2

A VIF of 10 is considered an upper limit the closer it is to zero the better the model is (Hair et al. 2018).

3.6. Conclusion

This chapter focuses on the research methodology, as applied in the research. It explains the research process by dividing it into six parts. The first section focuses on the review of the relevant research philosophies and theories from social sciences. The second section introduces the research design, technical models and concepts used in the study. The third development of theoretical framework adopted in the study of the sample. The fourth section describes the sampling issues and data collections process. The fifty section discusses the techniques of testing and the results analysis process and the conclusion as the last segment.

This research focuses on the performance interrelationship of CAPE with CAPM and the Fama-French Three Factors Model. As this study follows a quantitative research method using secondary data from various sources. The analysis of the behaviour of the CAPE ratio in the stock market of the London Stock Exchange with the Capital Asset Pricing Model (CAPM) and the Fama-French three-factor model, are the tools which are used to test the hypotheses and to achieve the purpose and study objectives.

This adds to the novelty of the study also. Following the research techniques, this research will significantly contribute to the understanding of how the asset pricing models perform at various stages of economic cycles when the market is priced fairly, under and over-priced. The next chapter will present the results and discussion of the CAPE ratio tests performed on the sample under study.

Chapter 4 – An Analysis of the Forecasting Ability of the CAPE Ratio

The main aim of this chapter is to evaluate the forecasting ability of the CAPE ratio if it is used as a valuation tool in trading strategies. This will be achieved by evaluating the performance of different trading strategies based on the CAPE ratio signals. These trading strategies will be evaluated in different time periods which are associated with different sentiments and business cycles. This will fulfil the research objective to apply the CAPE ratio on the London Stock Exchange and examine its usefulness during the different market trends and whether investors can achieve better returns using it. The analytical framework applied in this chapter will test the following hypotheses: H_0: the CAPE ratio cannot be used as a signalling tool to classify the market as under priced/overpriced/fairly priced. H_1: the CAPE ratio can be used as a signalling tool to classify the market as under priced/overpriced/fairly priced. This hypothesis framework along with the findings of the performance of the CAPE ratio-based trading strategies will provide answers to the following research question: Is the CAPE ratio a useful signalling tool in classifying the market as under priced/overpriced/fairly priced?

This chapter is divided into four sections. The first section will present the methodology to test the Cyclically Adjusted Price to Earnings (CAPE) ratio's signalling potential. The dataset and basic summary statistics are presented in second section. Additionally, the section presents the results of the application of the CAPE ratio in the London Stock Exchange dataset under study, which will determine the overpriced, fairly priced and under priced subsamples. Also, it will present the results of active investment strategy using the CAPE ratio with a passive investment strategy. It will also present CAPE ratio's levels during different historical events that occurred in the market. The third section will summarise and analyse the findings of the investment strategies. The final section will conclude the chapter.

4.1 Cyclically Adjusted Price to Earnings Ratio

The Cyclically Adjusted Price to Earnings (CAPE) ratio is an indicator of market's relative value and comes from the seminal work of Dr Robert Shiller and Dr John Campbell in Campbell and Shiller (1988, 1998) and Shiller (2005). As described by Faber (2014), CAPE is basically a security valuation method that is based on the inflated adjusted earnings over past ten years and the current market price of the stock. This ratio is an effective tool to smooth out business cycles, economic cycles, and price fluctuations. Shiller (2013) identify the CAPE ratio in the form of the following equation:

$$CAPE = \frac{Price}{Average\ Earnings\ for\ 10\ years\ adjusted\ for\ inflation} \qquad (4.1)$$

To adjust the average earnings in the light of the inflation, the following equation is applied:

$$EPS\ adjustement = \frac{Last\ 10\ years\ EPS\ X\ Inflation\ Multiplier}{10} \quad (4.2)$$

Where EPS is the earnings per share.

CAPE ratio is expected to provide signals about the valuation levels in the market, for example, when the market is overpriced, fairly priced and under priced (Faber 2014). As specified in Shiller (2013), if the ratio value is above 25, the market is considered too expensive relative to the market's earnings history and hence can be considered as overvalued. However, in some situations it might also be the case that the market has experienced strong growth over the past decade or perhaps that it is expected to grow higher in the near future. A CAPE value between 15 and 25 indicates that the market is considered fairly priced by looking at its past ten years of earnings data and when its value is below 15, the market can be considered as undervalued in the context of its earnings history.

Recently, the CAPE ratio has been studied in a variety of methods to test the potential of this ratio in terms of its signalling. Siegel (2016) argue that the CAPE ratio could be a good forecasting models for long-term future stock returns, but the use of GAAP earnings has affected its performance. Davis et al., (2018) claim that there has been a deterioration in the precision of the forecasts on stock returns in the U.S. made on the basis of the cyclically adjusted P/E (CAPE) starting in 1985 because no matter the macroeconomic situation, CAPE ratio mechanically returns to its long-run average. Therefore, they proposed an enhanced CAPE ratio that used a VAR based approach based on real bond yields, expected inflation rates, and financial volatility and found that the forecasted results are acceptable and statistically significant for both real and nominal returns. Waser (2021) also showed concerns about the CAPE ratio forecasts not being adjusted to the state of the economy. Thus, they tested their method using U.S economic variables and the S&P 500 CAPE ratio for the period between 1957-2017 and found that a CAPE ratio estimate based on economic variables explained about 90% of the CAPE ratio's variability.

Philips and Kobor (2020) improved the Shiller's CAPE methodology applied on the S&P500 and used one year filtered earnings instead of 10 years earnings and were able to reduce the standard deviation of forecast error by 40% for a 10-year return. Shelley et al., (2020) used the CAPE ratio yield spread, Fed Model, and Buffet's ratio and compared them to the equity allocation model; they applied them in an investment strategy reallocating the wealth between equity and the 10-year T-bonds on a sample from the S&P500 for the period between 1999-2018. They concluded that the equity allocation model outperformed the CAPE ratio and the other ratios. Theoretically several studies suggesting predictive power for the CAPE ratio signals, (Aydogan and Guney 1997; Aydoğan and Gürsoy 2000; Keimling 2016; Siegel 2016) whereas others dispute their usefulness, (Lewellen 2004; Welch and Goyal 2008; Davis, Aliaga-Díaz and Thomas 2012; Tilley 2018; Goyal, Welch and Zafirov 2021).

The CAPE ratio will be applied on the FTSE100 index series in this study to get the potential signals about the market in terms of an under priced, fairly priced and overpriced market for the period from December 1998 to December 2017. Then the CAPE ratio signals are used in an investment test to see if it can generate a higher return compared to a buy and hold return. In the next two chapters the CAPE ratio periods are used as subsamples to analyse the asset pricing models performance in those samples.

Although there are many studies on CAPE ratio (Keimling 2016; Siegel 2016; Asness, Ilmanen and Maloney 2017; Dimitrov and Jain 2018; Philips and Kobor 2020; Shelley, Traian and Trainor 2020; Peláez 2021) in recent years yet to the best of the authors knowledge none of these studies used CAPE ratio in a similar context in the London Stock Exchange market and hence this study aims to bring novelty to the existing literature on the subject.

4.1.1 Comparison Framework to Evaluate the Active Trading Strategy Using the CAPE Ratio

In order to test the signalling ability of the Cyclically Adjusted Price to Earnings (CAPE) ratio, the data sample under scrutiny is examined in the following two ways. In the first case, the average annual market return (r_m) for the full sample representing a passive investment strategy is calculated. In passive trading strategy, the investment position is not changed regardless of the market situation. The second method is an active investment strategy that is based on the CAPE ratio. The CAPE ratio will signal if the market is over or under priced. This investment strategy is based on the (CAPE) signals, and the investing position changes from the market to risk-free based on market situations. Finally, the average returns from these two trading strategies will be compared to determined which trading strategy would generate the best overall returns for investors. Waser (2021) and Siegel (2016) have used a similar methodology based on CAPE ratio using a sample from the S&P500. Peláez (2021) developed a relative total return CAPE ratio and found that it has a short-term signalling value.

The market is subsequently divided into different time periods, starting with the pre ‘dot com’ bubble, during the ‘dot com’ bubble period and after the ‘dot com’ bubble, the subprime mortgage bubble and finally the post subprime bubble. The same strategy used in the first part would be repeated over for each time period. Subsequently, in each time period, the output from the two trading strategies would be compared to determine the signalling potential for CAPE and the level of the stock market returns around these different historical events.

According to Pallant (2016), when comparing between two different mean scores for different trading strategies, t-test is used to examine the significance of the difference between them. It is useful in answering a research question about whether there is a difference between the means of two different subsamples. This type of tests assumes the normality of distribution. However, if the sample size is large enough violating the normality assumption should not be a major problem. In a small size sample, it could result in an insignificant outcome. After running the test if the t-test significance result is less than or equal to 0.10 it proves that there is a significant difference between the means. If it is more than 0.10 then there is no significant difference between the two means and the null hypothesis that the two means are not different cannot be rejected.

4.2 The Data Sample and Descriptive Statistics

This section presents the data and descriptive statistic that is being used to test the signalling ability of the CAPE ratio and the results of applying the detailed method in section 4.1 on the dataset. It is presented to give a better understanding of what is being analysed. The FTSE 100 index, which is the major index of the London Stock Exchange, will be used to highlight the trends and levels along with the CAPE ratio. The CAPE ratio for the FTSE 100 index will be used to identify the relative pricing levels in the market. The market return is used in evaluating and comparing the results of the two trading strategies. The risk-free rate is used as an alternative investment in the active investment strategy. To test the Cyclically Adjusted Price to Earnings (CAPE) ratio, this study will follow the steps outlined in Shiller (2013) to determine stock market phases. It would be interesting to see the relative performance of trading strategies using the CAPE ratio as a signalling tool.

As described by Campbell and Shiller (1998), the CAPE ratio may predict the direction of future returns by classifying the market into the following three categories: an under priced category when the CAPE ratio is below 15, a fairly priced category when the CAPE ratio is between 15 – 25 and an overpriced category market when the CAPE ratio is over 25. The expectations are that when the market is below or at a fair price there is a possibility of higher future returns, while any time it is overpriced, future returns should be less than the average expected returns.

	CAPE Ratio	FTSE 100	Market Return	Risk-Free Rate
Maximum	27.42	7687.77	0.0994	0.0048
Minimum	10.4	3578.67	-0.1324	0.0000008
Mean	16.11	5753.96	0.0056	0.0022
Stand Div.	4.27	929.55	0.0391	0.0018

Table 4.1 Basic summary statistics of the dataset used consisting of 229 monthly observation during 1998 and 2017. The CAPE ratio is calculated using the 10-year rolling average of EPS as described in Shiller and Campbell (1988)

Table 4.1 shows that the maximum value of the CAPE ratio in the sample under study is 27.42, which occurred in December 1999 and would be considered as an overpriced market as per the classifications associated with the CAPE ratio signals. The FTSE 100 at that time was at the level of 6930.2, which is the highest point the index reached before the Dot com financial crisis that started in the US financial market and affected stock markets around the globe. On the other hand, the lowest value of the CAPE ratios in the sample is 10.4 that shows an under priced market as per the classifications associated to the CAPE signal and it happened in February 2009 when the FTSE 100 was at 3830.09 level, which was during the subprime mortgage crises. The CAPE mean value is 16.11 that is on the lower end of the fairly priced market segment.

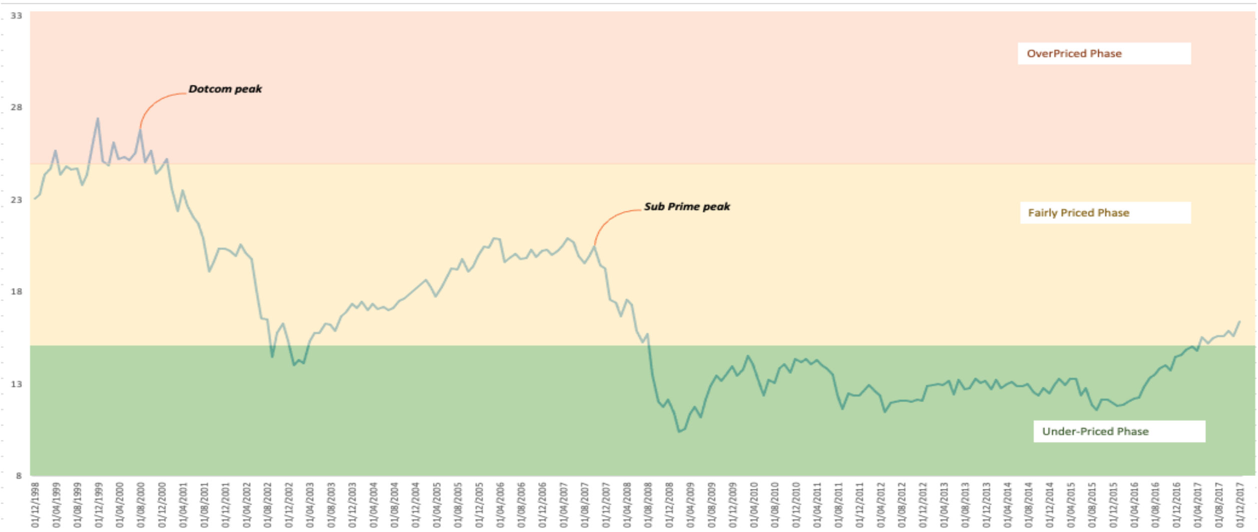

Figure 4.1 The plot of the monthly FTSE100 CAPE ratio with the pricing levels

Figure 4.1 demonstrates a graphical presentation of the CAPE ratio valuation levels. Along with the major events that happened in the market for the duration of the study. Table 4.2 Provides information of the main events in the financial markets during the sample period.

Periods	Start Date	End Date	CAPE Value at Start	CAPE Value at End	FTSE100 level at Start	FTSE100 level at End
All Sample	12/1998	12/2017	23.06	16.41	5882.6	7687.77
Pre Dot Com Crisis	12/1998	2/2000	23.06	24.87	5882.6	6232.56
Dot Com Crises	3/2000	9/2002	26.12	14.49	6445.17	3721.75
Post Dot Com Crises	10/2002	11/2007	15.74	19.44	4002.65	6432.45
Sub Prime Mortgage Crisis	12/2007	6/2009	19.28	11.21	6476.89	4249.21
Post Sub Prime Crisis	7/2009	12/2017	12.13	16.41	4631.61	7687.77

Table 4.2 The CAPE periods Beginnings and endings

As shown in Tables 4.2, the sample under examination was divided into different periods based on historical market events that occurred in the last twenty years. It starts with the pre-Dot com Bubble period, from the start of the sample to February 2000. From March 2000, when the market started to collapse until September 2002, this was under the influence of the Dot com crises that started in the United States market and spread to the global markets. This was the turn of the century and the first market correction initiated by the NASDAQ. Starting in October 2002, the market began to recover from the Dot com effect and started an uptrend, considering the end of the Dot com decline. However, in December 2007, new financial difficulties started due to the subprime mortgage crisis, which began in the United States and spread to all world markets. In July 2009, the market regained momentum and resumed an upward trend which was a clear signal of the end of the subprime crisis.

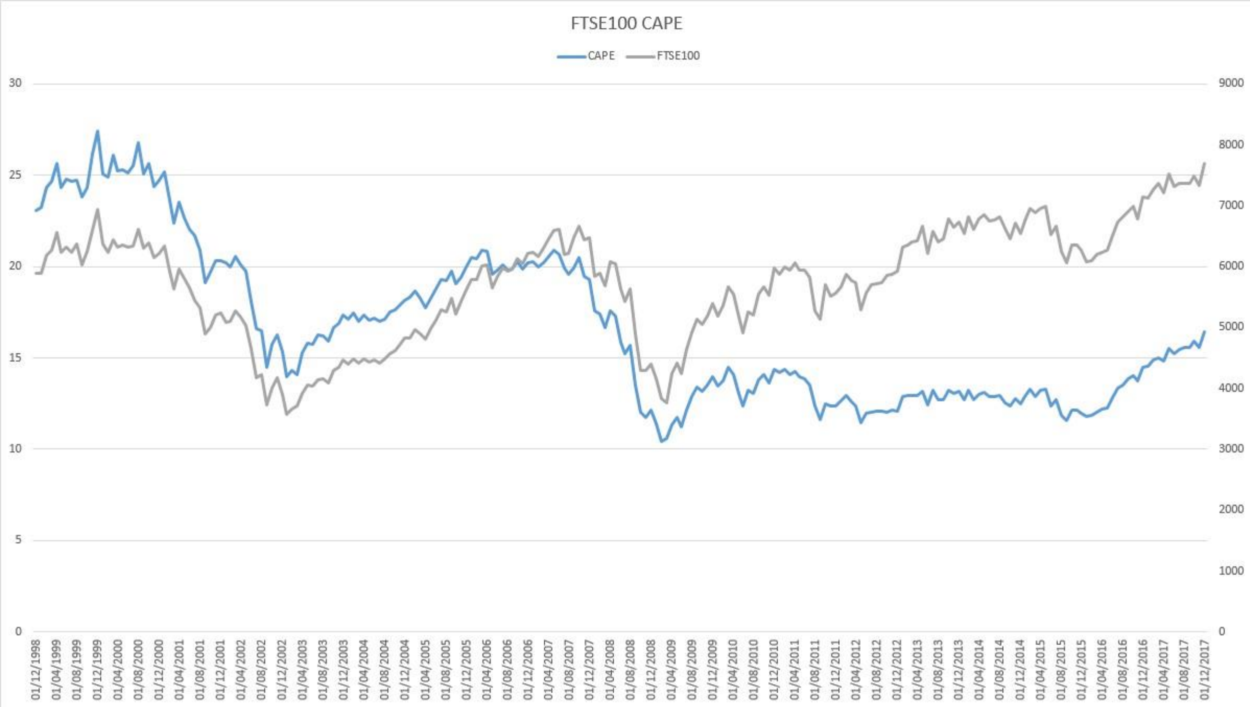

Figure 4.2 The monthly FTSE100 Index and CAPE ratio for the sample period under study

Figure 4.2 illustrates the monthly FTSE 100 index value and the monthly CAPE ratio levels for the period of the study. It can be seen that the CAPE follows the movements of the FTSE100 index. In any period where the index starts low and ends high, the CAPE starts low and ends high and vice versa. The only exception is when the entire sample is taken at once. Figure 4.3 shows that high equity market valuations as per the CAPE ratio precedes periods of low returns. The scatter chart shows that when the CAPE ratio was low, the future total return was higher than when the CAPE ratio was high.

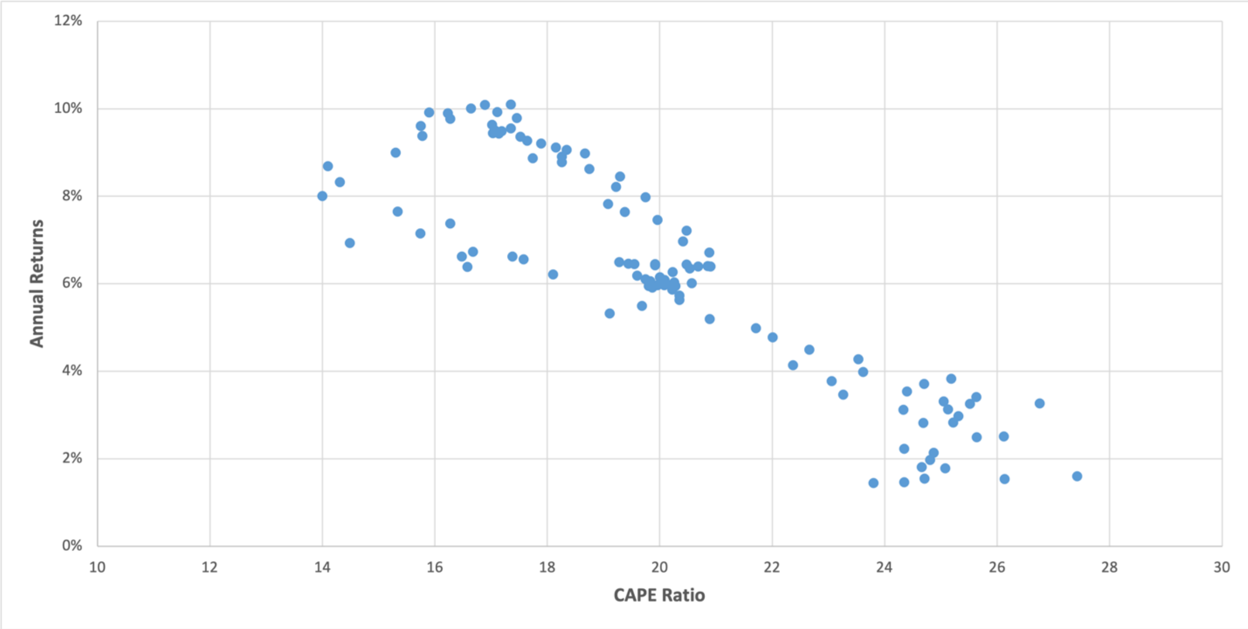

Figure 4.3 The CAPE value and the subsequent returns

Table 4.3 presents the comparison between the investment strategy detailed in section 4.1.1. A passive strategy is simply a buy and hold strategy, it takes the total return for the period from beginning to end. The active strategy switches between the market return and the risk-free return based on the signals from the CAPE ratio. Whenever the CAPE ratio passes the 25 levels the investment position is switched to the risk-free return and when it drops below the 25 levels the investment position is switched back to the market return. In most periods the passive investment was better than the active investment strategy.

Periods	Active Investment Strategy	Passive Investment Strategy
Full Sample	0.522%	0.561%
Pre Dot Com Crisis	0.42%	1.13%
Dot Com Crisis	0.00374%	-1.29938%
Post Dot Com Crisis	0.454%	1.292%
Sub Prime Crisis	-1.290%	-1.609%
Post Sub Prime Crisis	0.955%	1.002%

Table 4.3 The Active and Passive Investment Strategies Returns (A detailed table of the active investment strategy return calculations for the full sample is in Table A.1 in Appendix A)

4.3 Discussion of the Main Findings

After reviewing the data summary statistics and an analysis of the test results, this section will focus on discussing the results in the light of the research questions and test the underlying hypotheses. The scatter plot in Figure 4.3 shows the capability of the CAPE ratio in predicting future market returns. From the chart, it is seen that whenever the ratio was low future returns tend to be higher. Additionally, when the ratio is high future returns drop. This is similar to the findings of Keimling (2016) wherein their study examined the CAPE ratio on different EU

markets including the UK and found that when the CAPE is low the future market returns are high. Additionally, Li et al. (2020) results show similar finding as they tested a sample in the US market and found that the CAPE is a good long term predictor.
In Figure 4.2 both the CAPE ratio (in blue) and the FTSE100 index (in grey) always fluctuate in the same direction with small exceptions in a short period during the sampling periods. This demonstrates a correlation between the movements of the index and the CAPE. However, even if these move in the same direction, there are cases where the CAPE is at its all-time high or all-time low but the FTSE100 is not, and vice versa. For example, when the CAPE hit 27.42 in December 1999, this was its all-time high, but that was not the case with the FTSE100.

Table 4.2 shows that when comparing the percentage change between the start and end of the CAPE and the start and end of the FTSE100 index there appears to be a difference. In the first period when the whole sample was compared, towards the end the CAPE decreased by -28.84% while the FTSE100 increased by 30.67%. This shows a big difference between the start and end of the CAPE ratio and the index. It is vital to remember that the start of the sampling period was before the Dot com Bubble. However, the end was in a period following the sub-prime mortgage crisis, hence a period of recovery.

In the second period, the CAPE increased by 7.85% and the FTSE100 also increased but at a lower rate of 5.95%. This period lasted fourteen months and both started and ended with overpriced CAPE periods before the Dot com bubble. Comparing the average returns between the active investment and the passive investment shows a greater increase in the average market return of 0.71%. The difference here is much more than in the first period. Again, this is a negative point as neither a long term nor a short-term investment strategy is shown to fit CAPE.

The third period showed a decline of -44.53% in the CAPE and -42.26% in the FTSE100. The difference between the ratio and index changes is only 2.27%, which is not a big gap. The decline during this two-and-a-half-year period is expected considering it occurred during the Dot com Bubble. In terms of returns, unlike the previous two periods, the use of CAPE achieved a 1.30312% higher return than the average market return strategy. This could indicate that using the CAPE ratio could be an effective strategy during market corrections.

In the fourth period, both had a positive rate of change, for the CAPE of 23.51% while that for the FTSE100 was significantly higher, reaching 60.70%. This positive increase occurred during a five-year and one-month uptrend, marking the end of the previous bubble and a sharp change in direction in the market. With this bull market, the average market return has increased by 0.838% over the average investment return. This may support the findings of the studies that suggest that there is no significant advantage of using the CAPE as a signalling tool.

In the fifth period both declined, the percentage change in the CAPE was -41.86% and the FTSE100 was subject to a decreasing rate of -34.39%. The time frame for such a reduction is two and a half years, which was affected by the financial problems of subprime mortgages. In terms of the returns, in this period the CAPE ratio's strategy return was higher than the average market return. The average return on investment strategy was 2.9% higher. This once again confirms the point that using the ratio produces a better return during financial market downturns.

The sixth and final period is characterised by a 35.28% increase in the CAPE and 65.98% in the FTSE100. This uptrend period followed the subprime bubble and lasted eight years and five months. Comparing the investment return and the market return, the difference was less than 1%. Furthermore, when comparing the active investment strategy returns with the passive investment strategy return, as shown in Table 4.3, in the active investment strategy switching between the risk-free return and the market return occurred seven times. The performance of the passive investment was slightly better than the active investment by 0.092%. This shows that using the CAPE ratio and switching investment between the market return and risk-free return was not effective enough to achieve a higher return. While the difference is not huge between the two returns, it takes additional transactions, time and if transaction costs are added the gap will even widen.

	Passive	**Active**
Mean	0.005605585	0.005216826
Variance	0.001530875	0.001425614
T-stat	0.108195701	
Critical Value	1.648202066	

Table 4.4 The statistical comparison between the Active and Passive Investment Strategies Returns

The statistical differences between the two means for the full sample are presented in Table 4.4. This is to test the following hypotheses:
Hypotheses:

- H_0: $Mean_A - Mean_P \leq 0$
- H_1: $Mean_A - Mean_P > 0$

Since the t statistic value is not in the rejection region (less than the critical value) the null hypotheses cannot be rejected. Thus, there is not enough evidence to conclude that the total return under the active investment is greater than the passive investment. Even if the total returns from the active trading strategy are slighter more than the passive trading strategy, we need to consider the higher transaction cost in active trading strategy that can offset any small gains if any. In short, the results suggest that the trading strategy based on the CAPE ratio is not generating large enough returns, which are statistically different from the passive trading strategy. The transaction costs that an active investor incurs when switching between investment positions, which are between 1 and 2% will reduce the difference between the active and passive investment strategies in the long run.

These findings are in line with Feldman, Jung and Klein (2015) as they used CAPE in testing an active investment strategy with a U.S sample and concluded that the active investment strategy return was less than the S&P 500 return. Additionally, it is similar to Asness, Ilmanen and Maloney (2017) findings when they tested the out of sample dataset without the momentum factor. Also, it is consistent with Dimitrov and Jain (2018) argument that the CAPE ratio cannot help investors make higher earnings by switching between the risk-free asset and market return.

The failure of the CAPE ratio as an investment signalling tool can be related to issues in the way the ratio is calculated, which resulted in a misevaluation of the market. Like the use of a ten-year cyclical adjusting period that is way longer than any economic cycle, which can make the CAPE ratio to over or under evaluate the market as highlighted by Philips and Kobor (2020). Also, the changes in the accounting standers and the quality of the accounting data may result in a wrong CAPE ratio as emphasised by Sturgess (2012) and Siegel (2016).

4.4 Conclusion

In summary, this chapter intended to fulfil the second research objective that is: to construct the CAPE ratio on the LSE and examine how the ratio behaved during the different market trends and whether investors can achieve better returns by using it. A dataset from December 1998 to December 2017 was used to accomplish the test. In Figure 4.3 the forward-looking annualized market returns are plotted against the corresponding CAPE ratio level to test if the ratio's low level is associated with high future market returns. Figure 4.3 shows that high market returns are preceded by low CAPE ratio levels, which is in accordance with the findings of (Campbell and Shiller 1988; Shiller 2015).

Table 4.3 shows that relying on the CAPE ratio's signals before the occurrence of a market crisis and after the market correction, yield a lower return for an active investment compared to a passive investment. That is because the market is in an overvalued position according to the CAPE ratio, which makes the active investment out of the market and into the risk-free investment. However, during the crises, the CAPE ratio's signal saved the active investment from higher losses compared to the passive investment. Overall, from Table 4.4 the difference between the returns from the passive investment and the active investment is not statistically significant. Yet, if the transaction costs from switching between the market and the risk-free investment in the active strategy are considered the passive investment return will exceed the active investment return.

After applying the trading strategies on the dataset, the next step is to address the first research hypothesis which is as follows: H_0: the CAPE ratio cannot be used as a signalling tool to classify the market as under priced/overpriced/fairly priced. H_1: the CAPE ratio can be used as a signalling tool to classify the market as under priced / overpriced/fairly priced.

The overall results are not very conclusive and based on these results, it may not be possible to reject the null hypothesis. Test results show that the CAPE ratio was at a peak stage before the two financial crises. However, based on the results in Tables 4.3 and 4.4 an investor cannot beat the market return basing their investment strategy on the CAPE ratio signals as the results show that the returns are not significantly different. The transaction costs that the investor will have to incur in an active trading strategy will further reduce the overall returns. Thus, the outcome favours the passive trading strategy over the active trading strategy, which is similar to the findings of Feldman, Jung and Klein (2015), Asness, Ilmanen and Maloney (2017) and Dimitrov and Jain (2018).

Since the CAPE ratio fluctuations between the three market phases were not giving enough buy and sell signals and the market remains in the same phase for a long period of time, the CAPE ratio would not generate many transactions to exploit any arbitrage opportunities. The fact that there were very few signals coming from the CAPE ratio in the dataset about potential under-pricing or overpricing, this finding can support the Efficient Market Hypothesis (Fama, 1970, 1991).

The final step is to address the following research question: is the CAPE ratio a useful signalling tool in classifying the market as under priced/overpriced/fairly priced?

Based on the test results and the discussion in sections 4.2 and 4.3, the CAPE ratio does not appear to be a good forecasting tool for classifying the market as under priced, fairly priced and overpriced. As the results show that the CAPE ratio seems to classify the market as over and undervalued but when used as an input in trading strategies it is not helpful in generating excess returns. This could be due to the fact that the ratio is adjusted on a period of ten years whereas historical market cycles did not last that long. So, the ratio tends to misprice the market, which is highlighted in the findings of Feldman, Jung and Klein (2015), Asness, Ilmanen and Maloney (2017) and Dimitrov and Jain (2018). Moreover, the changes of the accounting standards over the years may play a role in the CAPE ratio's evaluation as mentioned by Sturgess (2012) and Siegel (2016).

This chapter has discussed and tested the CAPE ratio on a data sample from the London Stock Exchange (LSE) to see how well the ratio evaluates the market and to test it as a tool in investment trading strategies. This has clarified the research objective of examining the ratio and assessing its signalling ability during the different market sentiments and how useful its signals are in investment decision making. Now as those points have been clarified, the next point is to evaluate the performance of the Capital Asset Pricing Model (CAPE) during the different time periods as highlighted by the CAPE ratio, which will be discussed in the next chapter.

Chapter 5 - CAPE Ratio Signals and the analysis of subsequent returns in the light of the Capital Asset Pricing Model

This chapter will analyse the behaviour of stock returns in different time periods, which are highlighted as under priced, overpriced and fairly priced by the Cyclical Adjusted Price to Earnings (CAPE) ratio in the London Stock Exchange. More specifically, Capital Asset Pricing Model will be used to see if the stock returns are linearly related to systematic risk in all the different time periods which are classified by the CAPE ratio as under priced, overpriced and fairly priced. This will fulfil the third research objective. Five portfolios will be built based of the beta (systematic risk) of their companies. The returns of the portfolio will be analysed over three different CAPE ratio periods during the time frame of the study. Analysing the results of this exercise will help determine whether to accept or reject the following research hypothesis; H_0: There is no change in the performance of the CAPM under different time periods within this study. H_1: The performance of the CAPM is not similar in different time periods under study. The outcome of the above hypothesis, test results and subsequent discussion will provide answers to the following research question: Is the CAPM a suitable model in explaining asset's returns behaviours in different market situations as classified by the CAPE ratio?

This chapter is classified into four sections. The first section will describe the Capital Asset Pricing Model (CAPM). The next section will present the tests results coming out of all the samples. The third section will analyse the findings and test results. The final section will conclude the chapter by summarising the work, presenting the test results in the light of the research hypothesis and the research question.

5.1 Capital Asset Pricing Model

As described in the literature review chapter, the Capital Asset Pricing Model (CAPM) was the result of the combined work of Sharpe (1964), Lintner (1965) and Mossin (1966). According to Arnold (2007), the main purpose of the CAPM is to attempt to estimate the asset returns. Although the model divides the risk into two types systematic and unsystematic risk, only systematic risk is considered in the model, i.e., the risk associated with the market return. This is because unsystematic risk, i.e., the risk associated with the assets themselves, can be eliminated by investing in different assets.

As outlined in Arnold (2007), the CAPM has the following assumptions regarding investors and market operations; first, investors tend to be rational, utility-maximizing, and risk-averse.

Risk aversion denotes the characteristic of investors based on a desire to accept a given degree of risk as long as they believe that they will be compensated. However, such an assumption is not based on the thinking that all investors will have a matching level of risk aversion; they only need to be averse to risk. Utility maximization denotes those investors want the optimal return possible for the given level of risk, and those investors always want more wealth. Investors are known to make rational decisions based on correctly understanding, evaluating, and analysing information at their disposal. Notwithstanding that decision making by all rational investors is based on the same information and eventually read inherent risk in different ways, homogeneity among investors needs investors to be rational. Utility maximisation and risk aversion are universally perceived as a reflection of a realistic perspective of the world. However, there have been questions directed at how rational investors are based on the realisation that they sometimes allow their experiences and personal biases to get in the way of their thinking, leading them to make questionable investment decisions. Notwithstanding, the results of the model are not impacted by this type of irrational conduct as long as its effect on prices is not significant.

Second, there is no friction in the markets, including no taxes or costs related to transactions. Markets that are frictionless allow participants to use the operational elements of the markets to abstract analysis. By doing this, participants do not permit the risk-return relationship to be impacted by, for instance, the difference between the selling and buying prices or the NYSE trading volumes. Precisely, when markets are frictionless, it means that they are devoid of any limitations on costs such as short selling, taxes or transaction costs. The assumption is that lending or borrowing at a risk-free rate is possible. Many institutions do not get taxed, and their transaction costs are negligible. Notwithstanding the existence of any types of costs such as taxes, short selling and transaction costs or not being able to borrow at a risk-free rate has no material effect on the CAPM general conclusions. On the other hand, an upward bias in asset pricing can be introduced by short selling restrictions or the cost of short selling, which could potentially jeopardise crucial CAPM conclusions.

Third, the planning done by investors is for the same single holding period. As a single period model, CAPM is based on the assumption that all the decisions made by investors are based on a single period. The single period assumption is used for the sake of convenience because it could be a huge challenge to work with models covering multiple periods. The single-period model comes with the weakness that it does not allow learning to happen, which means that bad decisions could continue without being corrected. Added to this, utility maximisation when a multi-period end could need insights from decisions made in certain periods that could be perceived as suboptimal when looked at from a single period point of view. However, it is vital to note that the single period does not overly restrict the CAPM applicability in multi-period contexts.

Fourth, the beliefs and expectations of investors are homogenous. Behind such an assumption is the reasoning that the way in which investors analyse securities is similar. They employ similar probability distributions and future cash flow inputs. Considering the identical nature of their evaluations of all assets, they will create a similar optimal risky portfolio, called the market portfolio. Suppose the variances in expectations do not result in substantially varying optimal risky portfolios; it is possible to relax the assumptions of the homogenous beliefs.

Fifth, all investments are infinitely divisible, implying that an individual can invest as little or as much as they want in a specific asset. Such a presumption permits the model to depend on continuous functions as opposed to discrete jump functions. This is an assumption introduced for the sake of convenience, and its impact on the model's conclusion is inconsequential. Lastly, investors are price takers. CAPM operates on the assumption that investors are many and that there are no investors too big to single handily influence prices. This leads to the claim that investors are price takers, and the assumption is that the trading activities of investors do not affect security prices. Overall, this assumption is true in that although investors could sway the direction of the prices of small stocks, these stocks are too small to impact the CAPM's primary results.

The leading aim behind these assumptions is to establish a marginal investor with the capability to rationally select a mean-variance-efficient portfolio in a manner that can be described as predictable. This is assumed to remove any market inefficiency from both the informational and operational perspectives. Even though certain assumptions may look unrealistic, the relaxations of the majority of them will only impact the model and its results in a small way. Furthermore, with all its weaknesses and limitations, CAPM delivers a benchmark for comparing and generating initial estimates of return.

Therefore, for someone investing in stocks, it would require a risk premium to offset the non-diversified risk. The yield should exceed the risk-free rate to attract investors to the market. Based on this, the CAPM is presented in the following formula / equation:

$$r_i = r_f + \beta \times (r_m - r_f) \tag{5.1}$$

Where:

r_i: asset return for the 'i^{th}' asset

r_f: risk free rate

r_m: market return

The difference between the market return and the risk-free return is known as risk premium

The beta (β) is calculated as following:

$$\beta = \frac{\sigma\ (r_i, r_m)}{\sigma^2\ (r_m)} \tag{5.2}$$

5.1.1 Framework to evaluate the CAPM during the different time periods as highlighted by the CAPE ratio

Oldfield et al. (1981) studied CAPM on a U.S data sample and found a linear ex ante relationship between a security's return and the return on all assets. Fletcher and Hillier (2002) examined a dataset from the UK market for the period between 1955 – 1995 where they compared between a linear predictive regression and the CAPM in expected returns forecasts. Their findings favour the linear predictive regression over the CAPM. In a recent research paper on CAPM by Hasler and Martineau (2021), they showed that when market returns are expected to be high, the CAPM betas have the ability to forecast individual and portfolio stock returns.

To apply the CAPM in this study, all the listed stocks in the London Stock Exchange were included in the sample. Stock prices are used to calculate stock returns and their market betas were used to sort them into portfolios. Previous studies like Chelley-Steeley and Steeley (1995), Obrimah, Alabi and Ugo-Harry (2015) and Rojo-Suárez, Alonso-Conde and Ferrero-Pozo (2020) have also used stock portfolios in CAPM analysis. To construct portfolios some studies used a 30, 70 percentile break points and 50 percentiles break point (Gregory, Tharyan and Christidis 2013; Xiaofeng Shi, Dempsey and Irlicht 2015; Lambert, Fays and Hübner 2020). Other studies used a 12.5% break point resulting in eight portfolios (Bornholt 2013). There is no consistency or justification on which is a better method to be used, thus in this study the chose was to use five portfolios using the 20th, 40th, 60th and 80th percentiles as breaking points as this resulted in having portfolios with nearly an equal number of stocks.

Considering betas, stocks are sorted from lowest to highest values and then split into five different portfolios. The first portfolio contains stocks with the lowest betas up to the 20th percentile. The second portfolio includes all firms from the 20th to the 40th percentile. Those between the 40th and 60th percentiles will be in the third portfolio. The fourth includes all stocks between the 60th and 80th percentiles. The last portfolio is for the largest companies in terms of beta size, where they are all in the top 20 percentile. After grouping the stocks into different portfolios, the monthly returns (R) for each portfolio are calculated as follows:

$$R = \frac{P_t - P_{t-1}}{P_{t-1}} \qquad (5.3)$$

Where:
R: returns;
P_t: End Price;
$P_{t\,1}$: Beginning Price

Next, the risk-free (r_f) is subtracted from each portfolio's monthly returns to find the portfolio's excess monthly returns. Furthermore, the same process is applied to the monthly market returns (r_m) to produce the market premium.

The main tests are divided into four different phases. In the first phase, the test is performed over the entire time period of the sample. In the second phase, the data is tested over a period of time when the market price is under priced, as reported by the CAPE ratio. In the third phase, the data relates to the time period in which the market is reported as overpriced, while the last phase frame relates to a fairly priced market quotations based on the CAPE ratio signals. The next step will be to run the regression of the monthly excess returns of the portfolios on the market factor for each portfolio in each of the four phases as per the following regression formulae:

$$r_i - r_f = \alpha + \beta \times \left(r_m - r_f\right) + \varepsilon \qquad (5.4)$$

Where:

$(r_i - r_f)$: is the portfolio excess return,

α: estimated abnormal return on portfolio,

β: is the systematic risk for $(r_m - r_f)$: risk premium

ε: is the unsystematic risk.

The regression output would consist of regression alpha (α) intercept which represents the estimated abnormal return on investment in each of the five portfolios and its significance, the beta (β) coefficient of the risk premium (r_m-r_f) and its meaning and the term error (ε) representing the unsystematic risk of investing in each of the five portfolios. This is used to compare the behaviour of portfolios in each of the four phases mentioned above. Finally, the results between the different phases are compared and used to evaluate the research questions and test the hypothesis.

5.2 Portfolio Formation Criteria

This section will start by explaining the main criteria that has been adopted to form different portfolios that will be used to apply and test the Capital Asset Pricing Model. After performing the main tests, the results will be discussed in the following sections. Following the methodology described in the methodology chapter, the stocks have been grouped into five portfolios based on their (β) value whose contents are shown in Table 5.1. Subsequently, these five portfolios will be tested in each data subsample to determine their behaviour in different market situations.

Portfolio No.	No. of Stocks	Percentiles	Observations
P 1	117	1 to 19	229
P 2	122	20 to 39	229
P 3	114	40 to 59	229
P 4	120	60 to 79	229
P 5	115	80 to 100	229
Total	588	-	1145

Table 5.1 Portfolios formation

An important step in all the studies that test the CAPM is to conduct a regression analysis to be able to detect the nature of relationship of each portfolio return and if this is in line to portfolio beta. In each portfolio, the excess return of the portfolio, which represents the dependent variable in the model, is regressed on the market factor, which is the independent variable. In addition, the Durbin-Watson test was conducted to check for the presence of autocorrelation in data under examination. This will help to analyse if the market factor determines the excess portfolio returns and whether the intercept coefficient is statistically significant or not.

To analyse and discuss the performance of the Capital Asset Pricing Model (CAPM) in different time periods as per the signals of the Cyclically Adjusted Price to Earnings (CAPE) ratio, the data will be analysed using the following methodology. First, the whole sample will be tested from start to end. Second, the data set will be split into three subsamples, each representing one of three different sentiments as per the CAPE signals. The first subsample covers the period that CAPE medicates an undervalued market, the next section consists of a subsample where the CAPE indicates an overpriced market while the last subsample covers a period of a fairly priced market based on the signals from the CAPE ratio.

5.2.1 Analysis of Stock Returns in Full Sample

The main objective of analysing the full sample of data is to test the performance and suitability of the Capital Asset Pricing Model (CAPM) to forecast asset returns on the basis of the systematic risk factor. This will be used as a comparison to the results coming from subsamples based on the signals of the Cyclically Adjusted Price to Earnings (CAPE) ratio, and to evaluate the similarities or differences in the behaviour of stock returns. The full sample consists of 229 observations for each of the five portfolios representing monthly returns from December 1998 through December 2017. Table 5.2 shows a full description of the statistical data for all portfolios included in this section and the market factor which is used in the CAPM analysis.

Elements	Max	Min	Mean	Std. Deviation
P1 Excess Return	0.2361	-0.2109	0.009146	0.042798
P2 Excess Return	0.2063	-0.1873	0.007333	0.043151
P3 Excess Return	0.1598	-0.1578	0.00654	0.042615
P4 Excess Return	0.2333	-0.18318	0.00833	0.0484663
P5 Excess Return	0.25284	-0.21091	0.010677	0.052254
Ave. Risk Premium	0.09896	-0.1361	0.003450	0.039344

Table 5.2 The portfolios Descriptive Statistics in the full sample

The results seem to show that, in all portfolios, the null hypothesis indicating no intercept in the model can be rejected as the intercept is indeed significant. This indicates that the risk factor alone cannot explain all the portfolios returns and other factors are likely to be influencing the returns. Moreover, a relationship between the dependent variable (the excess return) and the explanatory variable (the market factor) seems to be significant, thus signalling, in all five portfolios, the importance of the market factor in explaining portfolio returns. No autocorrelation in residuals is being indicated and according to the adjusted R^2, the regression model shows that in portfolio P1 57% of the excess return can be explained by the market factor, which is the lowest of all five portfolios, the highest being 85% pertaining P5.

Portfolio No.	α	β	F test	R2 Adj R^2	Durbin Watson test statistic
P1	0.00631*** (0.002)	0.821*** (0.047)	300.293***	0.569 0.568	1.489
P2	0.004*** (0.001)	0.943*** (0.037)	643.081***	0.738 0.739	1.947
P3	0.003*** (0.001)	1.003*** (0.027)	1373.984***	0.858 0.858	1.910
P4	0.005*** (0.002)	1.063*** (0.041)	661.304***	0.743 0.744	1.986
P5	0.007*** (0.002)	1.109*** (0.049)	522.438***	0.696 0.697	1.891
(Standard Error) *** p<0.01, ** p<0.05, * p<0.1					

Table 5.3 Full Sample Regression Results

Following the regressions tests results for all the five portfolios under investigation as shown in Table 5.3, one can say that the null hypothesis that the Beta coefficient is equal to zero (β =0) can be rejected. So, the linear relationship between the independent variable and the dependent variable in all of the five portfolios fails to be disproved because the F tests for the models are highly significant at the 0.01 significance level.

Table (B.1 in Appendix B) shows the complete descriptive statistics of the residual predictions based on the regression tests for all five portfolios. The table shows that all the remaining averages of the five portfolios are very close to zero. This indicates that the variation between actual and predicted values is very small and that the two values are very close to each other. This shows a good prediction in all of the five portfolios models.

5.2.2 Analysis of Stock Returns in Subsample Classified as Under priced

This subsample is made up of 102 observations presenting the monthly returns of the five portfolios. The sample covers the period from September 2008 to February 2017. During this period, the Cyclically Adjusted Price to Earnings (CAPE) ratio indicated an undervalued market where the FTSE100 CAPE was below the level of 15. The Subprime Mortgage financial crises that triggered in the US markets and spread to UK financial markets began at the beginning of the subsample considered in this section, after which the markets found themselves in the aftermath of the financial turmoil. This likely indicates why the market was in an undervalued situation as it was recovering from a severe global economic downturn. Studying this sample of secondary data helps to understand portfolio return behaviour under the Capital Asset Pricing Model when the market is undervalued based on the CAPE ratio. The following section discusses the results following the application of the research methodology on this sample of secondary data.

Elements	Max	Min	Mean	Std. Deviation
P1 Excess Return	0.2361	-0.21087	0.0088311	0.045528
P2 Excess Return	0.2063	-0.1873	0.0092850	0.04395
P3 Excess Return	0.1598	-0.1578	0.0092485	0.044127
P4 Excess Return	0.2333	-0.18318	0.0107533	0.051582
P5 Excess Return	0.25284	-0.21091	0.013996	0.0574404
Ave. Risk Premium	0.09896	-0.13607	0.006554	0.0410352

Table 5.4 The portfolios Descriptive Statistics in the subsample 1

A descriptive statistic of the secondary data sample used in this section is shown in Table 5.4. This helps to understand what the data in each portfolio looks like and the market factor. After performing the regression test for all five portfolios, the regression results are presented in Table 5.5.

The model seems to be significant in all five portfolios, as their F-statistic's probabilities are strongly significant even at the 0.01 significance level. So, the null hypotheses that the model's coefficient is equal to zero ($\beta = 0$) is rejected. Thus, signifying that the linear relationship between the portfolio's excess returns and the market factor fails to be disproved. As in the P1, P2 and P4, the intercepts appear to be not significant, in these three portfolios the market factor was alone able to explain all the returns. In the other two portfolios where the intercepts are significant the market factor is not sufficient in explaining all the returns. Indicating that other factors have an effect on the portfolio's excess return. Since the market factor was highly significant in all portfolios, it is an important factor in the model. The Durbin-Watson test shows that the autocorrelation is absent in all five portfolios, and they all have considerable high goodness of fit.

Portfolio No.	α	β	F test	R2 Adj R^2	Durbin Watson test statistic
P1	0.002959 (0.003)	0.8960*** (0.065)	187.578***	0.652 0.649	1.574
P2	0.003103 (0.002)	0.9433*** (0.051)	345.879***	0.776 0.773	2.193
P3	0.002634* (0.002)	1.0093*** (0.037)	740.202***	0.881 0.880	2.096
P4	0.003553 (0.003)	1.0987*** (0.061)	323.618***	0.764 0.762	2.118
P5	0.006128** (0.003)	1.2006*** (0.072)	278.268***	0.736 0.733	2.017
(Standard Error) *** p<0.01, ** p<0.05, * p<0.1					

Table 5.5 Subsample 1 Regression Results

The case-by-case diagnostics summarised in the residual statistics in Table (B.2 in Appendix B) indicates that the forecasts are very close to the actual values across all portfolios. Hence, the average residual value is very close to zero. Furthermore, the standard deviation of the residuals and predicted values are very small.

5.2.3 Analysis of Stock Returns in Subsample Classified as Overpriced

The time period covered in this subsample starts in November 1999 and ends in January 2001. These are 15 observations representing the monthly returns of the five portfolios. During this time period the Cyclically Adjusted Price to Earnings (CAPE) ratio indicated an overpriced market where the FTSE100 was trading above the 25 CAPE ratio level. Earlier in this period a major financial crisis called the dot.com bubble hit the US markets and spread to the UK financial market. The financial outbreak erupted in March 2000 and continued until August 2002 when the market began to recover. Hence, the period covers a before and the beginning of a market correction. The following section discusses the results and the behaviour of the CAPM returns for this time period.

Elements	Max	Min	Mean	Std. Deviation
P1 Excess Return	0.0679	-0.0657	0.0271434	0.05096
P2 Excess Return	0.2063	-0.1873	0.0126744	0.03914
P3 Excess Return	0.0622	-0.0563	0.0104053	0.03874
P4 Excess Return	0.1087	-0.03924	0.0145264	0.039627
P5 Excess Return	0.0698	-0.06301	0.0092796	0.038450
Ave. Risk Premium	0.05998	-0.08623	0.000708	0.0418642

Table 5.6 The portfolios Descriptive Statistics in the subsample 2

The descriptive statistics for the secondary data sample of this subsection are presented in Table 5.6. It provides a general idea of the data from the five portfolios and the market factor used to analyse the behaviour of returns over this CAPE time period. Using this data, a regression test is performed with the excess returns of each portfolio as dependent variables and the market factors of each portfolio as independent variables. The result of the regression test is summarised in Table 5.7.

Portfolio No.	α	β	F test	R2 Adj R^2	Durbin Watson test statistic
P1	0.026807* (0.013)	0.4745 (0.311)	2.329	0.152 0.087	1.340
P2	0.012193 (0.007)	0.6795*** (0.178)	14.553***	0.528 0.492	2.049
P3	0.009852* (0.006)	0.7816*** (0.137)	32.368***	0.713 0.691	2.201
P4	0.013968** (0.006)	0.7884*** (0.145)	29.459***	0.694 0.670	1.629
P5	0.008758 (0.006)	0.7356*** (0.153)	23.255***	0.641 0.614	1.499
(Standard Error) *** p<0.01, ** p<0.05, * p<0.1					

Table 5.7 Subsample 2 Regression Results

The linear relationship between the portfolio's dependent variable (Excess Return) and the independent variable (Market Factor) fails to be disproved as the model's F-statistics seems to be strongly significant in all portfolios at the 0.01 significance levels rejecting the null hypotheses that the model coefficient is equal to zero (β =0). Except for the P1 portfolio as the model is F-statistics is insignificant. In the P1, P3 and P4 portfolios the intercept appears to have an effect on the model failing to disapprove that the market factor alone cannot explain all the returns in the model. However, in the other two portfolios P2 and P5 the intercepts seem to not have an effect on the model disapproving that other factors are needed to explain all the returns in the model. The market factor coefficient (β) was highly significant in four of the five portfolios P2, P3, P4 and P5. In the P1 portfolio where the model F test was not significant, the market factor coefficient was insignificant. The market factor coefficients in the P3, P4 and P5 portfolios are very close to one another in value. The P4's coefficient is the highest among them all at 0.7884.

Durbin-Watson tests for all five portfolios reveal the absence of any autocorrelation in the data set as they were all less than 2.5. In the insignificant model, the P1 portfolio, the goodness of fit shows that only 8.7% of the excess return can be explained by the market factor, which is extremely low. The highest goodness of fit appeared in the P3 portfolio where 69.1% of the dependent variable can be explained by the independent variable.

Table (B.3 in Appendix B) shows that all residual averages were very close to zero, thus indicating a very small difference between the actual and predicted values. The standard deviations of both the residuals and the predicted values appeared to be quite small. The insignificant P1 portfolio had the highest residual standard deviation at 0.046931. The standard deviations of the other portfolios were very close to each other, all approximately 0.02.

5.2.4 Analysis of Stock Returns in Subsample Classified as Fairly Priced

This secondary data sample represents a fair priced period of the FTSE100 according to signals from the Cyclically Adjusted Price to Earnings (CAPE) ratio. The sample is made up of 65 observations representing the five portfolios of the London Stock Exchange market. These are observations regarding the monthly returns of the portfolios under consideration. The sample runs from April 2003 to August 2008. During this time period, the market was experiencing the aftermath and recovery phase of the dot.com bubble financial crisis. Furthermore, towards the end of the time period, the financial market was entering the havoc wreaked by the subprime mortgage crisis also known as the Great Recession 2008, which is considered to be one of the major financial shocks to have occurred in the market. The following section discusses the regression results in the Capital Asset Pricing Model (CAPM) return analysis for this time period.

Elements	Max	Min	Mean	Std. Deviation
P1 Excess Return	0.0985	-0.0789	0.0110771	0.03518
P2 Excess Return	0.0880	-0.0920	0.0103854	0.037271
P3 Excess Return	0.0894	-0.0868	0.0088480	0.035159
P4 Excess Return	0.0939	-0.12559	0.0093025	0.042643
P5 Excess Return	0.1049	-0.11755	0.0120730	0.043499
Ave. Risk Premium	0.0909	-0.09073	0.0072448	0.030692

Table 5.8 The Portfolios Descriptive Statistics in the Subsample 3

To understand the data for each portfolio and the market factor, a descriptive statistical analysis of the sample of secondary data that is used in this section is shown in Table 5.8. For all five portfolios, a regression of excess return as a dependent variable and the market factor as an independent variable is completed. The regression results are summarised in Table 5.9.

Portfolio No.	α	β	F test	R2 Adj R^2	Durbin Watson test statistic
P1	0.004618 (0.003)	0.8915*** (0.091)	96.443***	0.605 0.599	1.242
P2	0.002881 (0.002)	1.0359*** (0.080)	168.318***	0.728 0.723	1.428
P3	0.001155 (0.002)	1.0619*** (0.054)	384.571***	0.859 0.857	1.614
P4	0.000662 (0.003)	1.1927*** (0.090)	176.439***	0.737 0.733	1.555
P5	0.003566 (0.003)	1.1742*** (0.100)	137.872***	0.686 0.681	1.549
(Standard Error) *** p<0.01, ** p<0.05, * p<0.1					

Table 5.9 Subsample 3 Regression Results

In all five portfolios, there is a presence of a useful linear relationship between the excess returns and the market factors as the model F-statistics is strongly significant at the 0.01 significance level in them all rejecting the null hypotheses that the model coefficients are equal to zero (β =0). The intercepts in those five portfolios do not have any effect on the regression models as they are not significant in any of them, which indicates that the market factor alone can explain all the returns in the model. The P4 portfolio had the highest market factor coefficient at 1.1927 and the P1 portfolio had the lowest at 0.8915.

Durbin-Watson tests across all five portfolios show the absence of autocorrelation as they were all below 2.5. In the P3 portfolio, 85.7% of the excess return (dependent variable) can be explained by the market factor (independent variable) making it the portfolio with the highest goodness-of-fit. The lowest goodness of fit is in the P1 portfolio with only less than 60% of the dependent variable being explained by the independent variable. The descriptive residual statistics in Table (B.4 in Appendix B) summarise the case-by-case diagnostics for all five portfolios studied over this time period. In all five portfolios, the residual averages are very close to zero indicating a small variation between forecast and actual values. Furthermore, the standard deviations are relatively small.

5.3 Discussion of the Findings

This section will indulge in discussing the output of the asset pricing model in the full sample and the three subsamples separated on the bases of the CAPE ratio levels. As highlighted in previous studies like Fletcher and Hillier (2002), Pedersen and Hwang (2007), Zabarankin, Pavlikov and Uryasev (2014) and O'Sullivan (2018) the significance of alpha is an important element in determining the fit of the model in the dataset. If the alpha is not significantly different from zero it would mean that variation in returns is explained by beta (systematic risk). But when the portfolio has a significant alpha that means that its returns are not in line with systematic risk, which can be an indication that investors may be able to earn more than risk adjusted returns. Therefore, when analysing the results and comparing between portfolios they will be evaluated firstly based on alpha and in the case where the alpha for two portfolios is equal and insignificant, the adjusted R^2 will be looked at to compare which portfolio is better in that particular situation. Additionally, the significance and the size of beta will be used in comparing each portfolio's results in the different stages of the market. The higher the beta value in a portfolio the more portfolio return are in line with systematic risk.

The summarised results in Table 5.10 show that in the full sample the CAPM does not perform well as the alpha is highly significant at the 0.01 significance level in all the five portfolios. This is an indication that the market factor alone may not be explaining all the returns in the dependant variable (the excess return), which is in line with Fama and French (1992, 1993, 1996, 2006) findings. Also, it is similar to the findings of Bornholt (2013) who applied the model on a US industry data and found that the longer time period, the lower the forecasting ability of the CAPM.

The CAPM model seems to perform well when applied to shorter subsamples identified by the CAPE ratio. The number of portfolios with significant alphas declined in shorter time periods as compared to the full sample. In the under priced sample only two portfolios had a significant alpha, in the overpriced sample three portfolios came with a significant alpha and none of the portfolios in the fairly priced sample showed a significant alpha. Bornholt (2013), found a similar conclusion when comparing the full sample to the shorter subsample, the CAPM model improved in the shorter subsample.

		P1	P2	P3	P4	P5
Full Sample	Alpha	0.006***	0.004***	0.003***	0.005***	0.007***
	Beta β	0.821***	0.943***	1.003***	1.063***	1.109***
	F-test	300.3***	643.1***	1374***	661.3***	522.4***
	Adj R^2	60%	70%	86%	74%	70%
Subsample 1	Alpha	0.003	0.003	0.003*	0.004	0.006**
	Beta β	0.896***	0.943***	1.009***	1.099***	1.2001***
	F-test	186.6***	345.9***	740.2***	323.6***	278.3***
	Adj R^2	65%	77%	88%	76%	73%
Subsample 2	Alpha	0.027*	0.012	0.010*	0.014**	0.008758
	Beta β	0.475	0.680***	0.7816***	0.788***	0.736***
	F-test	2.33	14.55***	32.37***	29.46***	23.26***
	Adj R^2	8%	49%	69%	67%	61%
Subsample 3	Alpha	0.005	0.003	0.001	0.001	0.004
	Beta β	0.892***	1.036***	1.062***	1.193***	1.174***
	F-test	96.44***	168.32***	384.57***	176.44***	137.87***
	Adj R^2	60%	72%	86%	73%	68%
***p<0.01, **p<0.05, *p<0.1						

Table 5.10 Summary of key results from the full sample and the three subsamples

The first portfolio's F-test, which comprises the stocks with the lowest beta, was highly significant in the first subsample, which highlights under priced market as per the CAPE ratio. As the adjusted R^2 was the highest showing that the market factor represents 65% of the portfolio excess return. The lowest performance was in the second subsample (the overpriced market as per the CAPE ratio). The portfolio's F-test and the beta were statistically insignificant, and the alpha was statistically significant at the 0.10 significance level. The only possible justification for the lack of statistical significance of the portfolio in overpriced sample is the limited number of observations, being only 15 monthly observations. This is also reflected in the goodness of fit (adjusted R^2) for the model which stands at only 8%. In the third subsample (the fairly priced market as per the CAPE ratio) adjusted R^2 was 60%, which is equal to the full sample's adjusted R^2. However, in the fairly priced sample the alpha was insignificant that improved the performance of the model in this period compared to the full sample.

The beta coefficient for the first portfolio came highly significant at the 0.01 significance level in the full sample, under priced sample and fairly priced sample. As mentioned above only the overpriced sample showed an insignificant beta. In the three samples with a significant beta, the beta values were very close to each other with the highest in the under priced sample at 0.896 and the lowest in the full sample at 0.821. This indicates that the portfolio risk and return does not change much from one period to the other.

The second portfolio had its best performance in the under priced sample as it had the smallest alpha value with an adjusted R^2 of 77% and an insignificant alpha. Again, similar to the first portfolio, the overpriced sample period had the highest alpha value (0.012) and the lowest adjusted R^2 for a portfolio (equal to 49%). The fairly priced sample ranked third at a 72% adjusted R^2. The alpha was insignificant in all the subsamples and was highly significant in the full sample. In this portfolio the beta coefficient was highly significant across the full sample and the three subsamples. The beta in the full sample and in the under priced sample are equal at 0.943. The highest beta came in the fairly priced sample at 1.036 and the lowest was in the overpriced sample at 0.680. So, in this portfolio returns are more in line with the systematic risk in a fairly priced market and a less in line with systematic risk in an overpriced market.

The third portfolio also had its highest adjusted R^2 in the under priced sample and the lowest in the overpriced sample. The full sample and fairly priced sample have similar characteristics as their adjusted R^2 are very close to each other at approximately 86%. However, the fairly priced sample period was the only one with an insignificant alpha making it the best CAPE level for the model in this portfolio. The alpha was significant at the 0.10 significance level in both the under priced and overpriced sample. In the full sample the alpha was highly significant at the 0.01 significance level.

Similar to the second portfolio the third portfolio's beta coefficient came highly significant at the 0.01 significance level in the full sample and the three subsamples. The beta in the full sample and the under priced sample were close to each other with a 0.006 difference favouring the under priced sample. The highest beta was in the fairly priced sample that was 1.062 indicating that the portfolio in a fairly priced market offers the highest return in line with the systematic risk of the portfolio. The lowest beta was in the overpriced sample at a value of 0.7816 providing the lowest return in line with the systematic risk of the portfolio.

The fourth portfolio had its highest adjusted R^2 in the under priced sample. Similarly, to the pervious portfolios the overpriced sample had the lowest adjusted R^2. Third was the full sample adjusted R^2 that was 1% higher than the subsample three adjusted R^2. Yet the alpha was insignificant in the fairly priced sample where it was highly significant at the 0.01 significance level in the full sample. Additionally, the alpha was significant in the second subsample, which affects the model. But insignificant in the under priced sample

In the fourth portfolio tests the beta came highly significant at the 0.01 significance level in all samples similar to the previous two portfolios. However, the value of beta differs from one sample to the other. The highest beta coefficient was in the fairly priced sample at 1.193 making it the highest period in terms of its return's alignment with its portfolio systematic risk. Similar to all the previous portfolios, the lowest beta was in the overpriced sample at 0.788 that makes it the lowest period with its return's alignment with its systematic risk.

The fifth portfolio, which holds the stocks with the highest betas, had its highest adjusted R^2 in the under priced sample. The second highest was in the full subsample that was about 2% higher than the one in the fairly priced sample. Yet, the alpha was insignificant in the fairly priced sample where it was highly significant in the full sample. The overpriced sample held the lowest adjusted R^2, and it was the period were also the alpha was insignificant. In the last portfolio the beta coefficient was the highest in the under priced sample at 1.2001, which makes it the highest period with returns more in line with the portfolio's systematic risk. The lowest was in the overpriced sample at 0.736.

The results show that the fairly priced sample was the best period for the CAPM model as all the portfolio alphas are insignificant and the adjusted R^2 was in a high acceptable level. Moreover, the beta value was considerably higher in the fairly priced period as compared to the other periods, which shows that returns are more in line with the systematic risk in this phase of the market. This indicates that the CAPM performed well in this time period as the market factor was clearly explaining portfolio's excess returns. That appears to weaken the importance of factors as highlighted by Fama and French (1992, 1993, 1996, 2006) and other studies that support multifactor asset pricing models like Carhart (1997). On the other hand, it failed in the full sample that is the longest time period.

However, there is no clear pattern for how the behaviour of stock returns. As they differ from one period to the other as they do not show a consistent behaviour based on the test results in the three subsamples and the full sample. Thus, the classification of the market valuation based on the CAPE ratio levels is questionable. The CAPE ratio's market classification is not consistent with the return's behaviour as per the CAPM. Those findings challenge the assumptions of Campbell and Shiller (1998) and support Feldman et al. (2015) in their criticism that the CAPE maybe misevaluating the market.

5.4 Conclusion

In conclusion, this chapter intended to fulfil the third research objective that is: to analyse stock returns behaviour using the CAPM during the three subsamples based on the CAPE ratio and compare it with the full sample to examine the similarities or differences in different situations and determine how good is this single asset pricing model in explaining the stock returns. For this purpose, five portfolios covering firms listed in the London Stock Exchange formed based on their beta size are used. Next, using the CAPE levels as presented in Chapter 4 the CAPM was tested in those subsamples and in the full sample for all the portfolios.

The main results show that, the only case where the value of the intercept (α) was highly significant at the (1%) significance level across all five portfolios was in the full sample containing the largest number of observations and the longest time frame. In contrast, in the fairly priced sample with a duration of 65 months in all five portfolios, intercepts appeared insignificant even at a level of 10%. The overpriced period that lasted only 15 months showed a slight increase insignificance compared to the fairly priced period portfolios with significant intercepts in two out of five portfolios with levels of 5% and 10%. However, it is the only period with an insignificant model. The under priced period which lasted for 102 months had a higher increase in the number of portfolios with significant intercepts than the overpriced period. Two portfolios had positive significant intercepts (alpha) and three were associated with insignificant intercepts in the under priced period. As the number of observations increases, more portfolios show significant alphas at different levels. This indicates that the longer the time period, the more factors are needed to explain market returns. Therefore, the capital asset pricing model, which is a single factor model, seems to be a more reliable model over a shorter period than longer time periods.

The statistical significance of the market factor is relatively high at a 1% level across all five portfolios across all the three subsamples except a single case where portfolio P1 in the overpriced time period was insignificant even at the 10% significance level. This can be considered an unusual case in the sample, in particular the fact that the number of observations in that specific time period was only 15, which is considered as a very small sample. This indicates a well-established factor in determining asset returns. Comparing the different time periods used in the study reveals that the overpriced period has the lowest market factor coefficients and the highest coefficients for intercepts. Indicating that returns are less in line with the portfolios systematic risk in this subsample compared to the other samples.

Comparing the stock returns across the full sample and the three subsamples from an investor's perspective, the results show that in subsamples the results are more reflective of systematic risk than the full sample. Specially in the fairly priced sample where all portfolios return reflected systematic risk as per the CAPM. Whereas in the under priced sample the P3 and P5 portfolios and the P1, P3 and P4 portfolios in the overpriced sample returns did not reflect systematic risk.

Based on the examination of the study's results, the null hypothesis: H_0: there is no change in the performance of the CAPM under different time periods within this study can be rejected as the outcome of the analysis shows that the performance of the CAPM is not consistent across the subsamples and in the full sample. In the light of the results the alternative hypothesis is accepted. The research question "if the CAPM is a suitable model in explaining assets behaviours in different market situations as classified by the CAPE ratio" can also be evaluated. Again, based on the outcome of this chapter's tests, CAPM does not appear to be a good model in explaining the behaviour of all the portfolios performance in the different CAPE ratio levels. Yet the model showed an improvement in its function in the subsamples compared to the full sample. This is consistent to the findings of Bornholt (2013) as in that study, the CAPM performance improved in the subsample when compared to the full sample.

This chapter has discussed and tested the CAPM in the different time periods classified by CAPE ratio in data sample from the London Stock Exchange. The main objective was to see how the CAPM performs in explain stock returns in different time periods which are classified by the CAPE ratio as under priced, overpriced and fairly priced. This has evaluated the research objective of examining the CAPM during the different CAPE ratio stages and assessing its behaviour during the different historical situations and how its signals could be used in investment decision making.

The overall analysis in this chapter does not come with any concrete finding which could help investors in developing trading strategies using CAPE ratio whereby they could expect returns which are definitely in line with the predictions of the CAPM. The next objective would be to evaluate the Fama and French three factors model behaviour during the different CAPE ratio levels, which will be discussed in the next chapter.

Chapter 6 - CAPE Ratio Signals and the Analysis of Subsequent Returns in the Light of Multi Factor Asset Pricing Models

This chapter will analyse the behaviour of stock returns in different time periods highlighted as under priced, overpriced and fairly priced by the CAPE ratio. More specifically, Fama and French Three Factor Model will be used to see if the stock returns are in line to the systematic risk factors specified in the multifactor model. This will fulfil the fourth research objective, which is to apply the Fama and French Three Factors Model on a sample from the London Stock Exchange to test the behaviour of stock portfolios during the subsamples based on the CAPE ratio signals and comparing it with the full sample to examine the stock return behaviour in those different valuation phases and to determine how good is this multi factor asset pricing model in explaining these returns.

As explained in the methodology chapter, six portfolios are formed on the basis of company size and if the stock is classified as value or growth stock. The Fama and French Three Factors model will be applied, and portfolio's returns will be analysed over three different valuation phases as highlighted by the CAPE ratio levels during the time frame of the study. Analysing the results of this test will help determine whether to accept or reject the following research hypothesis; H_0: There is no change in the performance of the Fama and French Three Factors model under different time periods within the study. H_1: The performance of the Fama and French Three Factors model is not similar in different subperiods within the study. The outcome of testing the above hypotheses and the subsequent analysis of this chapter's test results will provide answers to the following research question; Is the Fama and French Three Factors Model suitable in explaining assets behaviours in different market situations as classified by the CAPE ratio?

The chapter has been divided into four sections. The first section introduces the Fama and French Three Factors Model. Next section covers the outcome of the Fama and French Three Factor Model for the six portfolios across all four different time periods. The third section will present and explains the test results. The last section will conclude the chapter.

6.1 Fama-French three Factors Model

Fama and French (1993) added two additional factors to the existing CAPM to improve the explanation of the drivers of stock returns on top of systematic risk which is the single factor used in the CAPM. This Fama-French three factor model added value factor and a value premium (HML) that features the effects of value stocks on returns and a size factor and size premium (SMB) with the addition of these two risk factors, it is expected that the model will further explain the determinants of stock returns as compared to the Capital Asset Pricing Model.

According to Fama and French (1992, 1993), a crucial step in the model is to calculate the two additional factor betas and factor premiums (HML and SMB). To this end, the stocks in the market are grouped into three portfolios based on their book-to-market ratio (Book Equity/Market equity) Low value stocks (L), Medium value stocks (M) and high value stocks (H) and two portfolios based on their market capitalisation (size) small size stocks (S) and big size stocks (B). Next, six portfolios are created SH, SM, SL, BH, BM and BL and the returns are calculated for all six portfolios. Afterwards, the Small minus Big (SMB) factor is formed using the following formula:

$$SMB = \frac{(SH+SM+SL)}{3} - \frac{(BH+BM+BL)}{3} \quad (6.1)$$

The High minus Low (HML) factor is calculated with the following equation:

$$HML = \frac{(SH+BH)}{2} - \frac{(SL+BL)}{2} \quad (6.2)$$

After adding the two factors to the single factor asset pricing model, the three-factor model is represented by the following equation:

$$r_i = r_f + \beta 1\ (r_m - r_f) + s_i\,(SMB) + h_i\,(HML) \quad (6.3)$$

Where,
r_i = the portfolio return,
r_f = the return on the risk-free rate
β_1= the systematic risk coefficient,
$(r_m - r_f)$ = the excess market return (market risk factor),
s_i = the SMB coefficient
SMB = the small minus big market value,
h_i = the HML coefficient,
HML = the high minus low book to market value.

Next, the excess return on each portfolio is calculated by subtracting the risk-free rate (r_f) from the portfolio return (r_i). This is the independent variable that will be regressed on the three dependent variables (the three factors) using an ordinary least square (OLS) linear regression - to obtain the coefficients β_i, s_i and h_i - and the intercept α. Hence, the model can be written as the following equation:

$$r_i - r_f = \alpha + \beta_i*(r_m - r_f) + s_i(SMB) + h_i(HML) + \varepsilon \qquad (6.4)$$

Where,
$(r_i - r_f)$ = the excess return
α = the estimated abnormal return on portfolio,
β_i = the systematic risk (risk coefficient for $(r_m - r_f)$, the excess market return (market risk factor),
SMB = the small minus big market value,
h_i = the HML coefficient
HML = the high minus low book to market value
ε is the unsystematic risk,

6.1.1 Framework to evaluate the Fama-French three factor model during the different time periods as highlighted by the CAPE ratio

According to Griffin (2002), Fama and French model are best suited within country specific factors instead of global factors. Fletcher and Kihanda (2005) mentioned that there is not much evidence that supports a Fama and French three-factor model on a cross-section of stock returns at national level in the UK. Taneja (2010) studied the Capital Asset Pricing Model and Fama-French Model based on a sample of 187 firms. The study covers five years, between June 2004 and June 2009. The study provided evidence in support of Fama and French three factors model as a better model as compared to a single factor model.

To apply this model in this study, the factors data is obtained from the published work by Gregory et al., (2013). The monthly return of the six Fama and French three factor model portfolios and the FTSE All-Share index monthly factors of the Fama and French three factor model were downloaded from the University of Exeter Business School webpage. The three factors are the market factor $(r_m - r_f)$, the small minus big (*SMB*) factor and the high minus low (*HML*) factor.

The Fama and French Three-Factor Model will be examined on subsamples formed on the signals of the Cyclically Adjusted Price to Earning CAPE. The first period basically uses the entire data set regardless of the CAPE signals; the second is in under priced phase; the third covers the overpriced phase of the data set; and finally, the fourth period is the fairly priced phase of the sample. The model will then be applied over each period to measure the expected returns of the portfolios. Subsequently, the results will be analysed to determine the forecasting capacity of the CAPE ratio in terms of the explanation of stock returns in the light of risk factors. Additionally, the behaviour and characteristics of the model and its factors will be analysed to see any potential changes from one period to the other.

The risk-free rate (r_f) will be subtracted from each monthly portfolio return to develop the monthly excess return $(r_i - r_f)$. Next, the excess monthly return will be regressed over the three factors to calculate the coefficients for each factor, which are coefficient (β) for the market factor, coefficient (*s*) for the small minus big (SMB) factor and (*h*) coefficient for the high minus low (HML) factor. The final step is to analyse the results and compare the behaviour of returns at each of the different stages to test the research hypothesis and answer the research questions.

An important part in testing the Fama and French three factors model is the construction of the equity portfolios based on the factors specified in the model. Since the study's objective is to test the behaviour of the Fama and French three factor model during the different subsamples and to examine the performance of the SMB and HML factors. This study will use the six portfolios used to derive the SMB and HML factors in testing the model. Similar to the portfolios used in Gregory et al. (2013) in their study to test the different multi factor models.

Gregory et al. (2013) described the method used in the construction of the six portfolios: all financial stocks, foreign companies, and the Alternative Investment Market (AIM) were excluded while only the main market stocks were considered. Additionally, firms with missing or negative book values were discarded. The total sample number of listed companies in the UK main market with a valid book-to-market ratio and market size ranged between 896 in 1980 and 513 in 2010. The highest number of listed companies was in 1997 with a peak of 1323 stocks. The large number of small, illiquid stocks that major institutional investors do not trade, which incidentally make up a large part of the UK market, caused a problem in finding a UK equivalent for NYSE's breakpoints, which they are used to form the portfolios and factors in French's data library. So, to solve this problem, they only used the 350 largest companies, given the importance of considering what big investors invest in. Additionally, breakpoints of the 70th, 30th, and 50th percentiles are used in building and testing models. After identifying the companies and breakpoints in the data set, the equity portfolios are formed.

Gregory et al. (2013) sample is independently sorted based on the market capitalisation of the shares and the book-to-market ratio. Two groups are created based on market capitalisation (S, small, and B, large) using the median market capitalisation of the 350 largest firms as the breaking point of size. Three groups H, high, M, medium, and L, low, are created by sorting companies based on their book-to-market ratio using the 30th and 70th percentile breakpoints of the 350 largest stocks in the market. Hence, six SH, SM, SL, BH, BM and BL equity portfolios are formed from the intersection of the five groups. These portfolios are built in early October each year considering the largest UK listed firm's financial year end (Agarwal and Taffler, 2008; Gregory et al., 2013).

6.2 Sample Analysis

The data set in this section will be subjected to statistical tests to examine the behaviour of asset returns as per the signals of the CAPE ratio using the Fama and French three factor model. The data set analysis is divided into four different time periods. First, in section 6.2.1 the full sample where the entire data series is taken from start to finish in the analysis of portfolio returns. Second, in section 6.2.2 the first sub sample includes the CAPE ratio which is classified as an under priced market. Third, in section 6.2.3 the second subsample is presented where the CAPE ratio indicates an overpriced market. Finally, in section 6.2.4 the subsample where the CAPE ratio signals a fairly priced market signal will be evaluated.

The returns of each of the six different portfolios in both the full sample and each of the sub samples in the study will be regressed on risk factors to see which variables are significant and hence explain the variation in portfolio returns. More specifically, the excess return of each portfolio, which represents the dependent variable, is regressed on the market factor, the size factor, and the value factor which are the independent variables in the model. Furthermore, a Pearson correlation and a Multi-collinearity test will be considered to determine the presence of any relationship between the independent variables. The Durbin-Watson test will be conducted to verify any autocorrelations in the sample under examination. The main objective will be to verify if the market factor, the size factor and the value factor have statistical significance with the portfolio excess return. Furthermore, the statistical significance of the intercept will be tested to determine if the three factors are able to explain all the returns in the model.

6.2.1 Analysis of Stock Returns in Full Sample

The data set represents 37 years of monthly data from the London Stock Exchange, starting in October 1980 and ending in December 2017, amounting to 447 months. This section illustrates the results of applying the Fama and French Three-Factor Model on the whole set for all six portfolios. The objective is to test the behaviour of the portfolios when they are held for a long period and subsequently compare it with the investment strategy which is based on the Cyclically Adjusted Price to Earnings (CAPE) ratio that will be applied in the following sections.

Elements	Max	Min	Mean	Std. Deviation
SL Excess Return	0.2491	-0.2899	0.0057	0.0568
SM Excess Return	0.1978	-0.2618	0.0076	0.0493
SH Excess Return	0.2767	-0.2480	0.0087	0.0522
BL Excess Return	0.1433	-0.3249	0.0049	0.0441
BM Excess Return	0.1397	-0.2878	0.0053	0.0484
BH Excess Return	0.1454	-0.2496	0.0077	0.0501
Aver. Risk Premium	0.1328	-0.2706	0.0055	0.0440
Size Factor	0.1561	-0.1478	0.0013	0.0310
Value Factor	0.1229	-0.1861	0.0029	0.0315

Table 6.1 The portfolios and factors Descriptive Statistics in the full sample

Table 6.1 presents the descriptive statistics of the data sample used in the analysis. The average, maximum, minimum and standard deviation of each portfolio and factor used in the study shows a positive average monthly return and a close range of standard deviation across all portfolios and factors.

Factors	Market Factor	Size Factor	Value Factor
Aver. Risk Premium	1	-0.013	0.047
Size factor	-0.013	1	-0.066
Value factor	0.047	-0.066	1

Table 6.2 Pearson Correlations statistic between the systematic risk factors in the full sample

Table 6.2 provides the level of correlation between the three independent factors used in the Fama and French three factor model. This is the coefficient of correlation ($\frac{Cov(Y,X)}{(Var(Y)Var(X))^{0.5}}$). The test shows negative correlations between size and market factors and size and value factors and a positive relationship between market and value factors. The correlations were all less than 0.8. To analyse the data, the three factors are used as explanatory variables in the model whereas the market excess return is dependent variable.

Portfolios	α	β VIF	s VIF	h VIF
SL	0.00034 (0.001)	1.0229*** (0.017) 1.002	0.87793*** (0.025) 1.004	-0.49788*** (0.024) 1.007
SM	0.001102* (0.001)	0.92463*** (0.014) 1.002	0.8094125*** (0.019) 1.004	0.1164523*** (0.019) 1.007
SH	0.00102886* (0.001)	0.94569644*** (0.012) 1.002	0.82794*** (0.018) 1.004	0.4774*** (0.017) 1.007
BL	0.00165794** (0.001)	0.89770992*** (0.015) 1.002	-0.198517*** (0.021) 1.004	-0.475631*** (0.020) 1.007
BM	-0.000156049 (0.001)	1.02060253*** (0.019) 1.002	-0.13768*** (0.027) 1.004	0.02250699 (0.026) 1.007
BH	0.00096887 (0.001)	0.97490*** (0.018) 1.002	-0.148525*** (0.025) 1.004	0.549093*** (0.025) 1.007
(Standard Error) *** p<0.01, ** p<0.05, * p<0.1				

Table 6.3 The regression model output in the full sample

The regression output in Table 6.3 shows that the null hypothesis indicating no intercepts (α) in the model can be rejected in three portfolios: SM, SH and BL. This implies that the three factors in the Fama and French three factors model cannot explain all portfolio returns that could in fact be affected by other underlying factors. On the other hand, the same hypothesis cannot be rejected in the other three portfolios SL, BM and BH where the intercept is not statistically significant, demonstrating that the three factors can explain the returns of all portfolios.

Furthermore, a relationship between the dependent variable (excess portfolio return) and the independent variables (average risk premium (rmrf), size (SMB) and value (HML)) appears to be significant across all portfolios except the value factor in the BM portfolio, therefore, reporting that in all portfolios with significant factors the three factors are important to explain those portfolio returns. The Variance Inflation Factor (VIF) across all six three-factor portfolios is less than 5, which would seem to suggest that there is no multi-collinearity between the factors in each of the six portfolios.

Portfolios	R^2 Adj R^2	F test	Durbin-Watson
SL	0.920 0.9198	1705.15***	1.886
SM	0.935 0.93449242	2121.79***	1.808
SH	0.952 0.951273652	2903.39***	2.145
BL	0.906 0.905179119	1420.20***	2.131
BM	0.872 0.871568113	1009.89***	1.947
BH	0.894 0.893214221	1244.53***	1.733
*** p<0.01, ** p<0.05, * p<0.1			

Table 6.4 The full sample regression

Table 6.4 shows that all the six portfolios have a high goodness of fit as indicated by the adjusted R^2. The SH portfolio showed the highest goodness of fit among the six portfolios as 95.13% of the excess return (dependent variable) can be explained by the three factors (regressors). The lowest goodness of fit is associated with the BM portfolio as 87.16% of the regression can be explained by the predictors. This can imply that the null hypothesis can be rejected and a linear relationship between the independent variables and the dependent variable in all the six portfolios fails to be ignored because the coefficients are, highly, significant. All six portfolios show an absence of an autocorrelation as the Durbin-Watson tests are all less than 2.5.

Table (C.1 in Appendix C) summarised the descriptive statistics of the residuals. It is clear that all residual averages across all six portfolios are very close to zero, which indicates that the predicted values are very close to actual values. The standard deviation is small for the residuals in all six portfolios.

6.2.2 Analysis of Stock Returns in Subsample Classified as Under priced market

The first subsample covers the time period in the dataset where the CAPE ratio signalled the market as under priced and starts from September 2008 and ends in February 2017, i.e., 102 months with the FTSE 100 below a CAPE level of 15. The start of this period coincides with the financial crisis of subprime mortgages affecting financial markets around the world. Towards the end, the market began to recover in the aftermath of the financial recession.

Elements	Max	Min	Mean	Std. Deviation
SL Excess Return	0.1828	-0.1493	0.0107	0.04667
SM Excess Return	0.1978	-0.2248	0.01151	0.05007
SH Excess Return	0.2767	-0.2480	0.00883	0.06111
BL Excess Return	0.0771	-0.0939	0.00934	0.03443
BM Excess Return	0.0971	-0.1809	0.00754	0.04928
BH Excess Return	0.1215	-0.1530	0.00645	0.04765
Aver. Risk Premium	0.09896	-0.1361	0.00655	0.04104
Size Factor	0.15607	-0.1478	0.00257	0.03596
Value Factor	0.09006	-0.0701	-0.00238	0.026198

Table 6.5 The portfolios and factors Descriptive Statistics in the subsample 1

Table 6.5 summarises the mean, maximum, minimum, and standard deviation for all six portfolios and the three factors. All six portfolios show positive average monthly returns and relatively small standard deviations that are within a close range of each other. The average risk premium and the size factor both have a positive mean. The value factor is the only element with a negative mean in this sample of secondary data. The standard deviations of the three factors are considered to be small and in a very close range to each other.

Factors	Avg. Risk Premium	Size Factor	Value Factor
Avg. Risk Premium	1	0.080	0.532
Size factor	0.080	1	0.200
Value factor	0.532	0.200	1

Table 6.6 Pearson Correlations Statistic between the systematic risk factors in the subsample1

Pearson's correlation test in Table 6.6 shows the level of correlation between the three independent factors used in this data sample test which appears to be weak as none of them are in a range close to 1. Furthermore, the correlations among the factors are all positive. Compared to the full sample the correlation is higher in this subsample compared to the full sample. Also, in the full sample the correlation between the size factor and the average risk premium and between the size and value factors was all negative.

The first step is to use the factors for the duration of this sub-sample for all six portfolios and apply them in a regression with the portfolio's excess return as dependent variable and the three factors as predictors. The results will give an idea of the behaviour of the portfolios in this under priced market. This will help assess which is the best portfolio to be considered in such a time period.

Portfolios	α	β VIF	s VIF	h VIF
SL	0.001768 (0.002)	0.945238*** (0.046) 1.397	0.720744*** (0.045) 1.042	-0.367464*** (0.073) 1.445
SM	0.0031953** (0.001)	0.9144036*** (0.035) 1.397	0.828397*** (0.034) 1.042	-0.0840452 (0.055) 1.445
SH	0.0008737 (0.001)	1.0275862*** (0.036) 1.397	0.8380295*** (0.035) 1.042	0.3925324*** (0.057) 1.445
BL	0.0025496** (0.001)	0.8996018*** (0.036) 1.397	-0.153627*** (0.35) 1.042	-0.542882*** (0.057) 1.445
BM	-0.000157 (0.002)	1.1703723*** (0.056) 1.397	-0.188290*** (0.055) 1.042	-0.213217** (0.089) 1.445
BH	0.0034435** (0.001)	0.8172532*** (0.040) 1.397	-0.270912*** (0.39) 1.042	0.6971215*** (0.064) 1.445
(Standard Error) *** p<0.01, ** p<0.05, * p<0.1				

Table 6.7 The portfolios regression output in the subsample 1

The results in Table 6.7 show that the null hypothesis indicating no intercept (α) in the model can be rejected in three portfolios the SM, BL and BH as the intercept is indeed significant. This entails that the three factors in this model cannot explain all the portfolios returns while other factors are likely to impact the returns. On the other hand, the model cannot be rejected in the other three portfolios SL, SH and BM and BH where the intercept is indeed insignificant suggesting that the three factors seem to be able to explain all the portfolios returns. Additionally, a relationship between the regressed (portfolios excess returns) and the regressors (average risk premium (rmrf), size (SMB) and value (HML) factors) seems to be significant in all portfolios except the value factor in the SM portfolio. This appears to indicate that in all portfolios with significant factors the three factors are important in explaining those portfolio returns. The Variance Inflation Factor (VIF) in all of the six portfolios three factors are less than 5, which tend to confirm lack of multicollinearity between the factors in each one of the six portfolios.

Portfolios	R^2 Adj R^2	F test	Durbin-Watson
SL	0.887313819 0.88386424	257.224***	2.019
SM	0.943479558 0.94174934	545.295***	1.704
SH	0.959045657 0.95779195	764.970***	2.370
BL	0.873469792 0.86959642	225.506***	2.380
BM	0.848502720 0.84386505	182.959***	1.892
BH	0.916965291 0.91442341	360.743***	1.909
*** p<0.01, ** p<0.05, * p<0.1			

Table 6.8 The subsample 1 regression model results

Table 6.8 shows that the model in all six portfolios has high values of the adjusted R^2. The SH portfolio showed the highest goodness of fit among the six portfolios as 95.78% of the excess return can be explained by the regressors. The lowest goodness-of-fit is in the BM portfolio as 87.16% of the regressed can be explained by the predictors. All six portfolios show an absence of autocorrelation from the Durbin-Watson test result.

Table (C.2 in Appendix C) reveals that the expected residual values are very close to actual values because the residual averages across all six portfolios are very close to zero. Furthermore, the standard deviation for the residuals is found to be small in all six portfolios, being in a very close range between them.

6.2.3 Analysis of Stock Returns in Subsample Classified as Overpriced market

This section covers the time period reported as overpriced, as classified by the Cyclically Adjusted Price to Earnings (CAPE) ratio's upper band value of 25. The time period starts in November 1999 and ended in January 2001 covering 15 months of the FTSE100 index trading above of level 25 as peer the (CAPE) ratio. This time period includes the bursting of the dot.com bubble, which occurred since the start of the sample data in February 2000, and also the Dot com correction, which began in March 2000 and ended in August 2002. This section covers the behaviour of the returns of the Portfolios based on Fama and the French three-factor model in this reporting period (CAPE).

Elements	Max	Min	Mean	Std. Deviation
SL Excess Return	0.2491	-0.1967	0.01088	0.13060
SM Excess Return	0.0596	-0.0453	0.005196	0.034451
SH Excess Return	0.2767	-0.2480	0.013738	0.033764
BL Excess Return	0.0926	-0.0711	-0.0002	0.043435
BM Excess Return	0.0764	-0.1234	-0.0003	0.057491
BH Excess Return	0.1038	-0.1136	0.002309	0.05799
Aver. Risk Premium	0.05998	-0.0862	0.00071	0.04186
Size Factor	0.09791	-0.1000	0.00935	0.05528
Value Factor	0.12287	-0.1861	0.0027014	0.10174

Table 6.9 Descriptive Statistics in the subsample 2

Table 6.9 shows a descriptive statistic the mean, maximum, minimum, and standard deviation for the six portfolios and the three factors used in this sub data sample. Four portfolios the SL, SM, SH and BH show a positive mean and two portfolios the BL and BM have a negative mean. All the three factors have a positive mean. It is noted that the standard deviation for the SL portfolio is much higher than the other portfolios. Also, the value factor's standard deviation is higher than the standard deviation for the market and size factor.

The descriptive statistics for the mean, maximum, minimum and standard deviation for the six portfolios and three factors used in this secondary data sample are shown in Table 6.9. Four portfolios SL, SM, SH and BH show a positive average while the two portfolios BL and BM have a negative average. All three factors have a positive average. It can be seen that the standard deviation for the SL portfolio is much higher than that for the other portfolios. Furthermore, the standard deviation of the value factor is greater than the standard deviation of the market and the size factor.

Factors	Avg. Risk Premium	Size Factor	Value Factor
Avg. Risk Premium	1	-0.114	-0.212
Size factor	-0.114	1	-0.824
Value factor	-0.212	-0.824	1

Table 6.10 Pearson Correlations Statistic between the systematic risk factors in the subsample2

From Table 6.10 it is obvious that the relationship between the three factors is negative. Although there is no significant correlation between the market factor and the size factor and the market factor and the value factor since their values are all greater than -0.8, there appears to be a correlation between the value factor and the size factor as the value is slightly less than -0.8. The three factors in each of the six portfolios are used as explanatory variables in a regression with the excess return of each portfolio as a dependent variable.

Unlike the full sample in this subsample the correlation between the three factors is closer to zero.

Portfolios	α	β VIF	s VIF	h VIF
SL	0.0058863 (0.007)	1.06096345*** (0.201) 1.439	0.68757** (0.262) 4.282	-0.80916*** (0.145) 4.425
SM	-0.001765 (0.005)	0.59554709*** (0.133) 1.439	0.6595203*** (0.173) 4.282	0.1373781 (0.096) 4.425
SH	0.0043368 (0.003)	0.80866105*** (0.086) 1.439	0.7829252*** (0.112) 4.282	0.5575293*** (0.062) 4.425
BL	0.0050896 (0.003)	0.40596948*** (0.093) 1.439	-0.459723*** (0.121) 4.282	-0.487174*** (0.067) 4.425
BM	-0.003271 (0.005)	1.40093039*** (0.138) 1.439	0.1448165 (0.180) 4.282	0.2267857** (0.099) 4.425
BH	0.0066392 (0.008)	0.65827179** (0.224) 1.439	-0.555074* (0.292) 4.282	0.1461346 (0.161) 4.425
(Standard Error) *** p<0.01, ** p<0.05, * p<0.1				

Table 6.11 The portfolios regression output in the subsample 2

Looking at Table 6.11, the results show that the null hypothesis indicating the absence of an intercept (α) in the model cannot be rejected in all portfolios since the intercept is effectively insignificant. Furthermore, a relationship between the regressed and the regressors appears to be significant in most portfolios, except for the size factor in the BM portfolio and the value factor in the SM and BH portfolios. This means that in all portfolios with significant factors, the factors associated with them are important in explaining those portfolio returns. The Variance Inflation Factor (VIF) across all six portfolios with three factors is less than 5, which excludes multicollinearity among the factors in each of the six portfolios.

Portfolios	R^2 Adj R^2	F test	Durbin-Watson
SL	0.968354223 0.95972356	112.199	2.509
SM	0.801522942 0.74739283	14.807	2.190
SH	0.913898246 0.89041595	38.919	2.610
BL	0.938666479 0.92193916	56.116	2.476
BM	0.923034170 0.90204349	43.974	1.729
BH	0.800885208 0.74658117	14.748	2.488
*** p<0.01, ** p<0.05, * p<0.1			

Table 6.12 The subsample 2 regression model results

Table 6.12 summarises the goodness of fit, the significance of the models, and the autocorrelation tests for the six portfolios in this data sub sample. The adjusted R^2 shows that the model in all six portfolios has a high goodness of fit. The SL portfolio showed the highest goodness-of-fit among the six portfolios as 95.97% of the excess return can be explained by the three factors involved. The lowest goodness of fit concerns the BH portfolio with only 74.66% of the dependent variable explained by the independent variables. All portfolios except the SL and SH portfolios show no residual self-correlation. The two cases with a Durbin-Watson test above 2.5 should not be a concern because this data set is not a time series analysis, but a portfolio return set and since the portfolios are from the same market that causes some correlation. In a timeseries analysis, it is necessary to remedy autocorrelations of this type since price randomness assumed to be efficient for a market.

Table (C.3 in Appendix C) indicates that the variance between predicted residual values and actual values is very small, which therefore implies good prediction. Furthermore, the standard deviations across all six portfolios are in a very close range and considered to be of very low value.

6.2.4 Analysis of Stock Returns in Subsample Classified as Fairly Priced market

This sample presents the fairly priced period as classified by the Cyclically Adjusted Price to Earning (CAPE) ratio. This period started in April 2003 and lasted until August 2008 covering a period of 65 months based on the FTSE100 index between level 15 and 25 of the CAPE ratio. At the beginning of this time period, the market was in the recovery phase of the aftermath of the dot.com bubble. The last part of this sub sample covers the market behaviour in the subprime mortgage crisis that led to the financial crisis of 2009. The following section discusses the results of the regression results to analyse the yield behaviour of the six portfolios using the Fama and French Three-Factors Model.

Elements	Max	Min	Mean	Std. Deviation
SL Excess Return	0.1070	-0.1044	0.010136	0.043575
SM Excess Return	0.1055	-0.1057	0.0127723	0.04042
SH Excess Return	0.1335	-0.1092	0.0099393	0.04505
BL Excess Return	0.0957	-0.0795	0.006693	0.026799
BM Excess Return	0.1033	-0.0929	0.011199	0.038080
BH Excess Return	0.0916	-0.0895	0.00903596	0.03887
Aver. Risk Premium	0.0909	-0.0907	0.007245	0.030692
Size Factor	0.0727	-0.0789	0.001973	0.028947
Value Factor	0.0527	-0.0697	0.001073	0.020068

Table 6.13 The portfolios and factors Descriptive Statistics in the subsample 3

The mean, maximum, minimum, and standard deviation for the six portfolios and three factors are summarised in the descriptive statistics Table 6.13. All six portfolios and three factors show a positive average. The standard deviation for all portfolios and all factors is relatively small and lies in a range close to other.

Factors	Aver. Risk Premium	Size Factor	Value Factor
Aver. Risk Premium	1	0.170	0.297
Size factor	0.170	1	0.056
Value factor	0.297	0.056	1

Table 6.14 Pearson Correlations Statistic between the systematic risk factors in the subsample3

Table 6.14 summarises the Pearson correlations coefficients between the three factors. The relationship between the three factors is positive. Furthermore, none of the three factors have a strong significant correlation between them as verified by values below 0.8. Whereas in in the full sample the factor’s correlation are not as close to zero as the subsample’s results and the relation between the size and risk premium and the size and value factors were negatively related.

Portfolios	α	β VIF	s VIF	h VIF
SL	0.0013481 (0.002)	1.02248915*** (0.052) 1.126	0.847683*** (0.052) 1.030	-0.272658*** (0.078) 1.097
SM	0.0044219*** (0.001)	0.93420268*** (0.40) 1.126	0.7591659*** (0.40) 1.030	0.0784412 (0.060) 1.097
SH	0.0012104 (0.001)	0.88258004*** (0.038) 1.126	0.8902418*** (0.038) 1.030	0.5387023*** (0.057) 1.097
BL	0.0014549 (0.002)	0.82191780*** (0.055) 1.126	-0.137206** (0.055) 1.030	-0.415271*** (0.082) 1.097
BM	0.0039330 (0.003)	1.05552724*** (0.092) 1.126	-0.185937* (0.094) 1.030	0.0136127 (0.140) 1.097
BH	0.0015926 (0.002)	0.96182687*** (0.056) 1.126	- 0.179765*** (0.057) 1.030	0.7733684*** (0.085) 1.097
(Standard Error) *** p<0.01, ** p<0.05, * p<0.1				

Table 6.15 The portfolios regression output in subsample 3

Table 6.15 summarises the regression results for the six portfolios. The null hypothesis indicating the absence of intercept (α) in the model can be rejected for the SM portfolio where the intercept is significant. On the other hand, the model cannot be rejected in the other five portfolios where the intercept is really insignificant, which means that the three factors can explain all the returns of the portfolios. Furthermore, the relationship between the regressed and the predictors appears to be significant across all portfolios except the value factor in the SM and BM portfolios. It follows that in all portfolios with significant coefficients, the explanatory variables have predictive power. The Variance Inflation Factor (VIF) across all six three-factor portfolios is less than 5, suggesting the absence of multicollinearity.

Portfolios	R^2 Adj R^2	F test	Durbin-Watson
SL	0.928004543 0.92446378	262.092***	2.109
SM	0.950540523 0.94810809	390.778***	1.921
SH	0.964588683 0.96284714	553.871***	1.790
BL	0.788578095 0.77818030	75.841***	1.700
BM	0.699341678 0.68455520	47.296***	2.132
BH	0.893486215 0.88824783	170.565***	2.173
*** p<0.01, ** p<0.05, * p<0.1			

Table 6.16 The subsample 3 regression model results

The models show that all six portfolios have high goodness-of-fit as indicated by the adjusted R^2 Table 6.16, where the SH portfolio had the highest value of the six with 96.28% of the return in excess being explained by the three regressors. The lowest goodness of fit concerns the BM portfolio as only 68.46% of the regression can be explained by the predictors. All six portfolios reveal no autocorrelation as the Durbin-Watson tests are all below 2.5.

Table (C.4 in Appendix C) shows that the residual average across all six portfolios is very close to zero, which indicates that the discrepancy between the predicted and actual values is very small, making it a good forecast. The standard deviations of the residuals in all six portfolios are in a very close range and are considered to be of very low value.

6.3 Discussion of the Findings

This section will indulge in discussing the main findings of the tests based on the regression output from the full sample and the three subsamples separated on the bases of the CAPE ratio levels. As emphasised in previous studies like Foye, Mramor and Pahor (2013), Gregory, Tharyan and Christidis (2013), Xiaofeng Shi, Dempsey and Irlicht (2015), Tauscher and Wallmeier (2016) and Shaharuddin, Lau and Ahmad (2017) it is crucial to observe the alpha's when evaluating the asset pricing model. Moreover, the closer the alpha is to zero the better the model becomes. Therefore, when analysing the results and comparing between portfolios the alpha will be considered as the main measure in ranking the portfolios returns. Then, the comparison will be between the significance and size of the three factors used in the model.

When there are equal portfolios in their alphas the adjusted R^2 will be looked at to compare which portfolio is better in that particular situation.

The summarised results in Table 6.17 show that stock return behaviour and impact of risk factors was different in different portfolios from one time period to another. All six portfolios across the full sample and subsample periods showed highly significant model's F-tests at the 0.01 significance level and good model fit with adjusted R^2 ranging from 68% to 96%. This indicates that the Fama and French three factors model is a good model in explaining the excess returns of the portfolios across all the different periods covered in this study. This is in line with the findings of Gregory et al (2013) and Ahmad and Sanusi (2016) where they tested the model on different samples in the London Stock Exchange and found that it is a useful model in explaining returns in this market.

		SL	SM	SH	BL	BM	BH
Full Sample	α	0.0003	0.0011*	0.0010*	0.002**	-0.0002	0.001
	β	1.023***	0.925***	0.946***	0.898***	1.021***	0.975***
	s	0.878***	0.809***	0.828***	-0.199***	-0.138***	-0.149***
	h	-0.498***	0.116***	0.477***	-0.476***	0.023	0.549***
	F-test	1705.2***	2121.8***	2903.4***	1420.2***	1009.9***	1244.5***
	Adj R^2	92%	93%	95%	91%	87%	89%
Subsample 1	α	0.002	0.003**	0.001	0.003**	-0.0002	0.003**
	β	0.945***	0.914***	1.028***	0.810***	1.1704***	0.817***
	s	0.721***	0.828***	0.838***	-0.154***	-0.188***	-0.271***
	h	-0.367***	-0.084	0.393***	-0.543***	-0.213***	0.697***
	F-test	257.2***	545.3***	765***	225.5***	183***	360.7***
	Adj R^2	88%	94%	96%	87%	84%	91%
Subsample 2	α	0.006	-0.002	0.004	0.005	-0.003	0.007
	β	1.061***	0.596***	0.809***	0.406***	1.401***	0.658**
	s	0.688**	0.66***	0.783***	-0.46***	0.145	-0.555*
	h	-0.81***	0.137	0.558***	-0.487***	0.227**	0.146
	F-test	112.2***	14.8***	38.9***	56.1***	44***	14.7***
	Adj R^2	96%	75%	89%	92%	90%	75%
Subsample 3	α	0.001	0.004***	0.001	0.001	0.004	0.002
	β	1.022***	0.934***	0.883***	0.822***	1.056***	0.962***
	s	0.848***	0.759***	0.890***	-0.137**	-0.186*	-0.18***
	h	-0.273***	0.078	0.539***	-0.415***	0.014	0.773***
	F-test	262.1***	390.8***	553.9***	75.8***	47.3***	170.6***
	Adj R^2	92%	95%	96%	78%	68%	89%
*** p<0.01, ** p<0.05, * p<0.1							

Table 6.17 Summary of key results from the full sample and the three subsamples

Analysing each of the six portfolios individually across the different samples and time periods of the CAPE ratio helps to understand the characteristics of each of those portfolios in different situations. The small-sized low-value stock (SL) portfolio had an insignificant (α)

intercept over all time periods, indicating that in this type of portfolio, the three factors explain the variation in returns. Furthermore, it had a highly significant size factor (SMB) and value factor (HML) coefficients (i.e., at the 1% level) across all different market periods, except for the overpriced sample the size factor (SMB) where it was significant only at the 5% significance level. Furthermore, the size factor (SMB) had a positive value in all the different periods and the value factor is the second highest after the market factor (rmrf). The value factor (HML) had a negative value and was the lower of the other two factors. The portfolio had a special case in the overpriced sample in which both the size and value factor coefficients recorded the lowest value for both compared to their values in the other samples. However, the market factor coefficient had its highest value in that specific sample. The lowest market factor coefficient was in the under priced sample. The largest size factor coefficient was in the full sample and for the value factor coefficient was in the fairly priced sample.

The small size medium value stock (SM) portfolio had an insignificant intercept (α) only in the overpriced sample. That implies that in the overprice period the three factors were able to explain the variation in returns, but more factors are needed in the other periods. The size factor (SMB) had a strongly positive significant coefficient across all different time periods. Furthermore, the value of the size factor (SMB) was the second highest factor among the three factors. As regards the coefficient (*h*) of the value factor (HML) it was found to be significant only in one time periods, i.e., for the full sample. The coefficient of the value factor had the lower value than the other two factors. The portfolio in the overpriced sample had the lowest value for both market and size factors, and insignificant for the intercept and value factor.

The small-sized high-value stock (SH) portfolio had only a significant intercept that occurred in the full sample. That shows that the model in this portfolio is better in shorter time periods than a longer time period and more factors are needed in the full sample to explain the variation in returns of the portfolio. The coefficients of size (SMB), value (HML) and market (rmrf) factors were highly significant in all samples. In addition, all factors and intercepts had a positive value. Also, when comparing the value of the factors, the size factor (SMB) was the second highest, except in the fairly priced sample where it was the highest. The value factor (HML) has always been the lowest. What stands out is that, in the overpriced sample, the intercept was insignificant, and both the market coefficients and the size coefficients had their lowest values compared to the other samples, while the value factor coefficient recorded its highest factor in that sample.

The big size low-value stock (BL) portfolio showed insignificant intercepts in both overpriced and fairly priced samples. So, the three factors can explain all the variety of the excess portfolio returns in those sample and needs more factors in the other samples. All three factors showed highly significant coefficients in all samples except one case where the size factor coefficient was significant only at the 5% significance level in the fairly priced sample. Contrary to the market factor coefficient (rmrf), both the size (SMB) and value (HML) factors had negative values in all the different samples. In terms of the value of the factors, the size factor (SMB) was the second highest of the other two factors and the value factor (HML) was the lowest. The overpriced sample is distinguished by having an insignificant intercept and both the market and size factors coefficients recorded at their lowest value.

The big size medium value stock (BM) portfolio intercepts were insignificant in all samples. Indicating that no extra factors are needed in the model to explain the variety of returns in the portfolio's excess return. The size factor (SMB) coefficient (*s*) was negative and significant in all samples except the overpriced sample where it was insignificant. The value factor (HML) was insignificant in both the full and fair priced samples and significant in the other two samples with a negative value in the under priced sample. The full sample is distinguished by showing both insignificant intercept and value factor, the lowest value for the market factor coefficient and the highest value for the size factor. The second sample that stands out is the overpriced sample where both the intercept and the size factor are insignificant, and the market factor coefficient has its highest value, and the value factor coefficient has its lowest value.

The interception of the BH portfolio of big size high-value stocks was insignificant in all samples except the under priced sample where it was significant. Thus, more factors are needed in the under priced sample to be able to explain the variety of the excess return in the portfolio. All three factors were highly significant in all time periods except in the overpriced sample the size factor (SMB) coefficient (*s*) was significant only at the 10% significance level and the value factor (HML) coefficient (*h*) was insignificant. On the other hand, the size factor (SMB) was negative in all time periods unlike the market (rmrf) and value (HML) factors which were positive in all time periods. Clearly both the full sample and the overpriced sample had special features for the BH portfolio. In the full sample the intercept was insignificant and both the values of the market coefficient and that of the size factor coefficient were higher than their values in the other samples and the value of the value factor coefficient was the lowest in this sample compared to its value in the other samples. In the overpriced sample, both the intercept coefficient and the value factor coefficient were insignificant, and the market and size factor coefficients had their lowest values in this sample.

The intercept in the regression models used in the different data samples was mostly insignificant except in three portfolios, SM, SH and BL, in the full sample and SM, BL and BH, in the under priced sample and one case the SM portfolio in the fairly priced sample where in the overpriced sample the intercept was insignificant in all portfolios.
What emerges is that in all the different market situations and conditions the marginal effect of the average risk premium was positive and highly significant (1%). The coefficient (β) of the average risk premium is not only highly significant across all six portfolios, but also always positive. Furthermore, in each portfolio when comparing the values of each of the three factors the average risk premium has the highest value except in two cases, namely the SH portfolio in the fairly priced sample and the SM portfolio in the overpriced sample where in both the size factor (SMB) was the highest and the average risk premium was the second highest.

This seems to highlight the importance of the market factor and its essentiality in the model, having a strong effect on the return on investment. Indicating that the market factor is essential in determining the risk of the investment for investors. This is in line with the findings of Markowitz (1952). Also, it reassures the established theory of Sharp (1964) and Linter (1965) as they emphasised the importance of the market factor. Moreover, it is another proof of the effectiveness of this factor even in recent years as mentioned by (Bornholt 2013).

The size factor (SMB) ranked second in terms of the number of times its coefficient was significant in different scenarios. It was highly significant across all six portfolios in both the full sample and the under priced sub-sample. In the overpriced sub sample, it was highly significant at the 1% significance level in only three portfolios, which are SM, SH and BL. For SL it was significant at the 5% significance level and for BH it was significant at the 10% significance level. However, for BM portfolio it was insignificant. In the fairly priced period, it was also significant in four portfolios which are SL, SM, SH and BH and significant at the 5% significance level in BL and BM. Since only in one situation the size factor was not significant in all portfolios but at different levels. In SL, SM, SH and BH it was significant at the 1% significance level. In BL and BM it was significant at the 5% and 10% significance level, respectively.

Therefore, it is considered a crucial factor in the model. Meaning that the size factor influences the risk of the investment. This comes in line with the findings of Fama and French (1993). Moreover, other studies who test multi assets models in the London Stock Exchange such as Gregory et al (2013) and Ahmad and Sanusi (2016) have concluded the importance of this factor in this market. It was also found to be the second important factor after the market factor.

The value factor (HML) has had the most insignificant situations where its coefficient (*h*) has a p-value greater than 0.10. In both the whole sample period and the under priced sample, it was insignificant in one portfolio case, i.e., the BM portfolio in the full sample and the SM portfolio in the under priced sample. Both the overpriced and fairly priced samples had two instances of an insignificant value factor that occurred in the SM and BH and SM and BM portfolios, respectively. The value factor was highly significant at the 1% significance level in all other portfolios across all different data samples, except the BM portfolio in the under priced sample and the BH portfolio in the overpriced one where the value factor was significant at the 5% significance level.

Since the cases of a significant value factor are more than the insignificant cases, the value factor is vital in the model but is not as strong as the other two factors. This also confirms the findings of Fama and French (1993) that the value factor has an important risk effect. Furthermore, previous studies on the London Stock Exchange such as Gregory et al (2013) and Ahmad and Sanusi (2016) have found that the value factor has an effect in the market, and it ranks third after the market and size factors.

Comparing the average returns across different portfolios over each time period shows that in the full sample the ranking of high to low yielding portfolios sees the small size high value (SH) portfolio in the lead with higher average yields equal 0.0087. It is followed by the big size high value (BH), second with an average yield of 0.0077. Then comes the small size medium value (SM) portfolio with an average return of 0.0076. Afterwards, it is the small size large value (SL) portfolio with an average return of 0.0057. The last is the big size medium value (BM) portfolio with an average return of 0.0053 and the lowest is the big size large value (BL) portfolio with an average return of 0.0049.

In the under-price sample the rank and mean performance were as follows: SM 0.001151, SL 0.0107, BL 0.00934, SH 0.00883, BM 0.000754 and the minimum was BH 0.00645. In the overpriced sample it resulted as SH 0.01374, SL 0.0109, SM 0.005196, BH 0.00231, BL -0.0002 and BM -0.0003. In the fairly priced sample is was SM 0.01277, BM, 0.0112, SL 0.01014, SH 0.00994, BH 0.00904 and the last was BL 0.00669. It is obvious that portfolios with small stocks always ranked first and those with large stocks came in last.

When comparing the performance of each portfolio across the different samples, the SL portfolio achieved the highest average returns in sub sample 2 (overpriced period) with an average of 0.0109. The latter was in sub sample 1 (under priced) with an average of 0.0107. The third was sub sample 3 (fair price) with a mean of 0.01014 and the minimum yield was in the full sample with a mean of 0.0057. For the SM portfolio it is like the following fairly priced sample, under priced sample, full sample and overpriced sample. For the SH portfolio it is overpriced sample, fairly priced sample, under priced sample and full sample. In the BL portfolio it is under priced sample, fairly priced sample, full sample and overpriced sample where the portfolio had a losing average of -0.0002. In the BM portfolio it is fairly priced sample, under priced sample, the full sample and overpriced sample was a loss of -0.0003. The final BH ranking of the portfolio was fairly priced sample, full sample, under priced sample and overpriced sample. It is evident that none of the portfolios achieved the highest return when held for a long period of time as in the full sample.

Observing the sample test results, it shows that the highest returns is always in a subsample and never in the full sample. So, following the CAPE ratio levels can yield a higher return by selecting the portfolio that performs the best in that CAPE period. However, there is no consistency in the portfolio’s characteristics in each CAPE ratio period and the behaviour from one period to the other is not in a similar pattern. That challenges the CPAE ratio market valuation as presented by Campbell and Shiller (1998). Accordingly, this may pose questioning on the usefulness of CAPE ratio as a tool for valuation of the market as highlighted by Feldman et al. (2015).

6.4 Conclusion

To summary, the objective of this chapter is to address the fourth research objective, which is to apply the Fama and French Three Factors Model on a sample from the London Stock Exchange to test the asset portfolios return behaviour during the three subsamples formed based on the signals from the CAPE ratio and compare it with the full sample to examine the mispricing and behaviour changes in those different situations and determine how good is this multi asset pricing model in explaining the returns. Six portfolios built on the bases of Fama and French (1993) method for extracting the extra factors the size and value were used in this study.

After testing the Fame and French Three-Factors Model at the London Stock Exchange, the results show that the average risk premium stands strong as an important factor in the model. Furthermore, the size factor (SMB) appeared to be the second strongest predictor in the model. The value factor (HML) was not as significant as the other two factors, especially in SM and BM portfolios, where it presented as the least significant. Therefore, the model stands strong in the market. This is in line with the findings of Gregory et al (2013) and Ahmad and Sanusi (2016).

Regarding the use of the Cyclically Adjusted Price to Earnings (CAPE) ratio as a signalling too in trading, the ratio showed mixed results in the six portfolios during its different phases. During the overpriced sample all six portfolios' intercepts were insignificant. The market factor coefficient recorded its lowest value across all portfolios during this sample with two exceptions, the SL and BM portfolios had the highest market factor coefficient in the overpriced sample. The size factor coefficient showed its lowest value in the overpriced sample and was also insignificant in the BM portfolio in this sample; with the exception of the SH portfolio where the factor had its highest value and the BL portfolio, where the coefficient was not the lowest and the coefficient of the value factor was not significant or recorded its lowest value during the overpriced sample.

Hence, the characteristics of the overpriced period are non-significant intercepts while most of the coefficients recorded the lowest value in this time period. In the fairly priced period none of the coefficients had the lowest value in this sample and the intercept was not significant except in the SM portfolio where however the coefficient of the value factor was also not significant and was the only portfolio in which the coefficient of the market factor had its highest value. Furthermore, none of the significant coefficients had their lowest value during this period. The under priced sample had the highest number of significant intercepts and the lowest period with non-significant factors as it showed only one portfolio and one non-significant value factor which was the SM portfolio. When comparing the entire sample to the three CAPE subsamples, the sample does not have a competitive advantage that is better or worse than the CAPE subsamples.

The outcome of the tests performed in this chapter on the data sample support the rejection of the following null research hypotheses H_0: there is no change in the performance of the Fama and French Three Factors model under different time periods within this study. As it is clear from the test results that the portfolio's characteristics differ in each CAPE ratio level and their behaviour from one period to the other are not similar. This may suggest that the CAPE ratio may be helpful in indicating in which type of market sentiments investors may expect stock return which are in line with the predictions of the Fama and French three factors model.

To address the third research question if the Fama and French Three Factors Model is suitable in explaining assets behaviours in different market situations as classified by the CAPE ratio? The results show that the model was able to explain the variation of returns and risk in the portfolio's excess returns very well. As the majority of the portfolios had a significant market, size and value factors in them and the intercept appeared to be insignificant in the majority of the portfolio's situations. This is in line with other studies that tested the model on samples from the London Stock Exchange like Gregory et al (2013) and Ahmad and Sanusi (2016).

This chapter has discussed and tested the Fama and French Three Factors Model in the different CAPE ratio periods on a data sample from the London Stock Exchange. The main objective was to see how the model behaves with the changes in the CAPE ratio levels. This has clarified the research objective examining the Fama and French Three Factors Model on a sample from the London Stock Exchange as per the different CAPE ratio signals and assessing its behaviour during the different market sentiments and how it could be used in investment decision making. The next step is to summaries the thesis and clarify its contribution, limitations, and future research suggestions.

Chapter 7 – Conclusion

This chapter will summarise the key research findings of the thesis concerning the study's aim, objectives, and research questions, in addition to the key findings and contributions of the thesis. Moreover, the study's limitations will be reviewed, and future research opportunities are suggested. The aim of this chapter will be to highlight each research objective, summarizing the method used to achieve it and the discussion related to it. It will then cover the research questions and the hypothesis that relate to it. Finally, it will reflect on the contributions it made to the existing body of knowledge and research frontiers. The last part of the chapter will cover the research limitations and suggestions for further research.

The main aim of this research is to investigate and analyse the signalling capability of the CAPE ratio and to analyse the performance of asset pricing models in the different phases of the market, as highlighted by the CAPE ratio. These phases are classified as overpriced, fairly priced and under priced valuation in the market. The findings of the study indicate that relying on the CAPE ratio to enter or exit an investment position will most likely not benefit the investor in achieving a return higher than the passive investment strategy. As the results show that a buy and hold investment approach yield a higher return compared to an active investment strategy using the CAPE ratio as the main indicator for the investment decision. The asset pricing models results show that both the single and multi factor asset pricing models performed better in the subsamples as compared to the full sample. However, there was no clear pattern in the performance of these models when the market switches from one CAPE ratio level to the other. Thus, the Efficient Market Hypothesis stands strong in its conviction that the financial markets are efficient all the time.

The first research objective was to critically review the relevant literature on the CAPE ratio and the asset pricing models, especially that is linked to market sentiments. It becomes obvious how important this objective is after examining the main theoretical propositions that are the basis of this thesis. Critically evaluating the assumptions that govern the decisions, judgements, and preferences of equity markets investors is inevitable because this thesis proposes to examine the Efficient Market Hypothesis by analysing the performance of asset pricing models in the different valuation levels of the CAPE ratio for stocks in the London Stock Exchange. By providing an overview of the Efficient Market Hypothesis, asset pricing models, and the CAPE ratio, this task is accomplished in Chapter two.

Several strong assumptions underlie the Efficient Market Hypothesis, including investor rationality, risk aversion, perfect capital markets without frictions, and easy access to information by all market participants. Despite the great debate over the validity of these assumptions, financial economic researchers tend to accept them because their predictions seem to represent the reality adequately (Szyszka, 2013). Although standard finance theories are challenged by the accumulation of puzzles, researchers are reconsidering the validity of these assumptions, resulting in theories that are based on the opinion that investors may not act rationally and that the market itself is also irrational as a result of arbitrage limits (Barberis and Thaler, 2003).

The Efficient Market Hypothesis and the mainstream financial asset pricing models underlying assumptions led to generally distinctive implications for asset pricing, and particularly for the relationship between return and risk (Shefrin and Belotti, 2008). Despite the fact that sentiments play an important function in asset pricing, Statman et al. (2008) assert that conventional asset pricing relies only on utilitarian factors that solely represent risk. Even though the Efficient Market Hypothesis and asset pricing models' assumptions seem unrealistic, it does not imply that conventional asset pricing models are unreliable. As Lucas (1980) points out, a reliable model is not necessarily more realistic. Instead, a reliable model would rather explain reality more accurately.

The second research objective was to construct the CAPE ratio for the London Stock Exchange and examine how the ratio behaved during the different market trends and to see its signalling capacity in terms of different valuation levels. To achieve the research objective, the CAPE ratio similar to the one that Campbell and Shiller (1988, 1998) constructed on the S&P500 was used on the FTSE100 as it is that main index for the London Stock Exchange. As per the CAPE ratio levels, market was classified as overpriced, fairly priced and under priced in the dataset understudy. In the light of these signals, the longest period with a continuous overpriced market was identified to be used as a subsample, similarly a period with a fairly priced and a period with an under priced market were identified to be used in achieving the third and fourth research objectives.

The main test conducted on the dataset was investigation of an active investment trading strategy whereby the CAPE ratio was used as a signalling tool to enter and exit the investment as used in other studies such as Feldman, Jung and Klein (2015). The rule was to switch between investing in the market and investing in a risk-free asset. Whenever the CAPE ratio shows an overpriced market, the investment is switched from the market to the risk-free asset. When the CAPE ratio signals a fairly priced market after an overpriced market, the investment is switched from the risk-free investment to the market again. Then the return is calculated for the period of the study and compared to the return of a passive investment strategy where the investment is kept in the market for the entire duration of the study. The results showed that total returns from the passive investment strategy is higher than the active investment strategy. Besides, when the additional trading related transactions of switching between the market and the risk-free asset are included, the returns difference will increase further favouring the passive investment approach. Hence, basing the investment position on the CAPE ratio level signals, most likely will not give a higher investment return when compared to buying and holding the investment in the market for a longer time period. This comes in line with previous similar studies conducted on the U.S market (Feldman, Jung and Klein 2015; Asness, Ilmanen and Maloney 2017; Dimitrov and Jain 2018). Based on these findings, the first null research hypothesis that the CAPE ratio cannot be used as a signalling tool to classify the market as under priced/overpriced cannot be rejected. To address the first research question, is the CAPE ratio a useful signalling tool in classifying the market as under priced/fairly priced/overpriced? As it is apparent from the test results that the CAPE ratio failed to provide useful investment signals, which casts doubt on its usefulness in identifying the different market valuation levels. In short, CAPE ratio does not seem to be a useful signalling tool for classifying the market valuation levels as under priced, fairly priced or overpriced.

The third research objective was to analyse the performance of the Capital Asset Pricing Model (CAPM) in different market phases as highlighted by the CAPE ratio signals. To accomplish this objective, five portfolios built on the stock's beta (β) level were used to test the CAPM model. The CAPM was tested in subsamples similar to Bornholt (2013) approach, but the subsamples were based on the CAPE ratio levels. The first subsample was the under priced covering the period from September 2008 to February 2017. Next is the overpriced subsample covering the period from November 1999 to January 2001. The last subsample is the fairly priced sample covering the period from April 2003 to August 2008. The results of those subsamples were compared in the light of the performance of the CAPM in the full sample that covers the period from December 1998 to December 2017.

The regression results show that the stock returns were not in line to the predictions of the CAPM in the full sample because the alpha was highly significant in all portfolios which indicates that the single factor (systematic risk) is not sufficient in explaining all the variation in the portfolio's excess returns. That is in line with Fama and French (1992, 1993) findings. Additionally, it is in agreement with Bornholt (2013) results on his full sample CAPM model test. The results in the subsamples as highlighted by the CAPE ratio showed an improvement in the CAPM model performance. The fairly priced subsample was the best as the alpha's was insignificant in all portfolios and very close to zero and the risk premium coefficient was highly significant with a high goodness of fit for the model. That gives an indication that the CAPM model was fit to explain all the variation in the portfolio's excess returns without needing any other explanatory factors. The under priced subsample had only two cases of significant alphas, yet both were not highly significant as in the full sample. In the overpriced sample, three portfolios had significant alphas and they too were not as highly significant as the full sample. Thus, the CAPM model's performance is considered better in the subsamples compared to the full sample. That confirms the findings of Bornholt (2013) when they compared the outcome of the full and subsamples.

In light of these findings, the second research hypothesis that there is no change in the performance of the CAPM under different time periods within this study can be rejected. As the results show that the CAPM performance has changed specially from the full sample to the subsamples. To fulfil the related research question; "is the CAPM a suitable model in explaining assets behaviours in different market situations as classified by the CAPE ratio?" Even though the CAPM showed an improvement in explaining the returns of the portfolio's excess returns in the subsamples compared to the full sample, there was not a clear pattern of the CAPM model behaviour in the different subsamples. Therefore, it does not appear to highlight any significant differences in explaining the stocks behaviour in the market phases as highlighted by the CAPE ratio.

The last research objective was to analyse the performance of the Fama and French three factors model in different market phases as highlighted by the CAPE ratio. To complete this task, six portfolios have been used. Those portfolios are built using Gregory et al (2013) method that is built on the Fama and French (1993) procedure. That is by grouping the London Stock Exchange shares into three portfolios based on their book-to-market ratio Low value stocks (L), Medium value stocks (M) and high value stocks (H) and two portfolios based on their market capitalisation (size) small size stocks (S) and big size stocks (B). Next, six portfolios are created by combining those stocks as into those portfolios SH, SM, SL, BH, BM and BL and the returns are calculated for all six portfolios. Those portfolios were then tested in the full sample period and the three CAPE ratio subsamples to analyse their performance.

The results revealed that the Fama and French Three Factors Model is a good fit model in explaining the excess returns of the stock portfolios as the F-tests were highly significant and the model's goodness of fit (Adjusted R^2) were in high levels. This is in line with previous literature, for example, Gregory et al (2013) and Ahmad and Sanusi (2016). To be more precise, the alpha in the overpriced subsample was insignificant in all portfolios indicating that the factors included in the study are enough to explain the variation in the portfolio's excess returns making this subsample the best performing sample compared to the other subsamples and the full sample. Then comes the fairly priced subsample with only one portfolio with a significant alpha. The full sample and the under priced subsample both had three significant alpha portfolios, however, the under priced subsample portfolios had a higher significant level compared to the full sample portfolios.

The systematic risk factor coefficient was the only highly significant coefficient in all portfolios across the full sample and the three subsamples as highlighted by the CAPE ratio. This indicates the importance of this factor in determining the expected returns in the market. The second important factor seems to be the SMB as its coefficient was significant in all portfolios across all periods with a single case of insignificance in the overpriced subsample. The HML factor seems to have the most insignificant coefficient. It had an insignificant case in one portfolio in the full sample and the under priced subsample and two cases in the overpriced and fairly priced samples.

The only portfolio that had an insignificant alpha and significant factors coefficients in the full sample and the three CAPE ratio subsamples is the SL portfolio making it the portfolio in which the returns were most in line with the predictions of Fama and French three factors model. The SM portfolio was the only portfolio with an insignificant HML (value) coefficient in all the three CAPE ratio. That shows that in short time periods the value factor does not affect the SM portfolio returns. The SH portfolio was the only portfolio that performed better in the three subsamples compared to the full sample. As the alpha coefficient was significant in the full sample but insignificant in the three subsamples, which indicate that in the full sample more factors are needed to explain the variation in the excess return but that is not the case in the three subsamples as highlighted by the CAPE ratio.

From this analysis, the third research hypothesis that there is no change in the performance of the Fama and French three factors model under different time periods within this study can be rejected. It is also noted that the performance of the model from one period to the other is not consistent. To address the third research question; “is the Fama and French three factors model a suitable model in explaining assets behaviours in different market situations as classified by the CAPE ratio?”, the results show that the Fama and French three factors model was a suitable model in explaining most portfolios in the full sample and the three subsamples. These findings are in line with the findings of Gregory et al (2013) and Ahmad and Sanusi (2016).

The final research question “what are the implication for the Efficient Market Hypothesis if the CAPE ratio provides credible signals about market under-pricing, fairly pricing or overpricing?”

was analysed next. Even though the CAPE ratio showed a credible signal in predicting future market returns as explained in Chapter 4 and the asset pricing models showed improvements in the subsamples as compared to the full sample; yet it was not possible to beat the passive portfolios. Nor was the performance of the asset pricing model consistent in the CAPE ratio levels making it hard to classify the best investing option based on the CAPE ratio signals. Thus, the Efficient Market Hypothesis stands strong in its belief that markets are efficient all the time and there are no arbitrage opportunities that investors can exploit by analysing the market direction.

In the light of the results, Efficient Market Hypothesis cannot be rejected because our findings have shown that the CAPE ratio is not clearly highlighting market under pricing (overpricing) and even if it is correctly highlighting the trading results based on the CAPE signals, the active trading strategy returns are not significantly different from the passive trading strategy. In the light of these results, it can be declared that markets are efficient, it is not easy to forecast the future direction in these markets, there is no significant under pricing or overpricing, price changes are based on new information and the arrival and type of new information is random in the financial market.

Even if the asset pricing models results were showing a consistent behaviour in different phases of the market as highlighted by the CAPE ratio, it could have been taken as an indication of lack of arbitrage opportunities. Then it could be said that the CAPE ratio cannot be used to generate excess returns. As the market remains in a certain CAPE ratio level for a good amount of time and the CAPE ratio itself does not fluctuate much between its three levels, it did not help in signalling any opportunities of excess returns and arbitrages. Thus, this finding supports the Efficient Market Hypothesis.

While the results did not support the use of the CAPE ratio, yet it remains a good signalling tool. Since all other factors are not constant in this time period CAPE ratio may have been right in identifying the market as overpriced (under priced) but since there was so much quantitative easing that occurred specially after the subprime mortgages crisis it did not generate positive returns. The actions of central banks in artificially supporting the markets with so much new money may have affected the strength of CAPE ratio's market valuation signals. Hence, even if the CAPE ratio has correctly signalled that it is an overpriced market and it would crash but the additional new money which has been channelled into the markets would have delayed the corrections in the market. Therefore, in a way the CAPE ratio may have been correct but since it was not possible to keep other things constant for example the money supply, so it was difficult to test it. As interest rates have been kept deliberately so low, to save the economy by keeping bonds yields low so that companies can borrow cheaply and when they are able to borrow cheaply, the bankruptcy risk goes down and stock prices will not crash. Accordingly, correction in the market is delayed due to the very loose monetary policies and that affects testing the signalling capability of the CAPE ratio.

Considering the analysis and results obtained in this study, it contributed to theoretical debate in the area of Efficient Market Hypothesis. As, the analysis has provided fresh insight on the Efficient Market Hypothesis, that the market seems to be efficient all the time and prices seems to reflect all the information and this new tool is not able to identify correctly under priced or overpriced periods because if markets were really under priced or overpriced than the trading strategy based on CAPE would have generated excess returns as compared to buy and hold strategy. Also, in both asset pricing models the alpha coefficients were not significant in any one particular phase of the CAPE ratio market levels. So, this study has contributed to the theoretical debate on efficient market hypothesis by providing fresh insights supporting the Efficient Market Hypothesis. Furthermore, it evaluated the CAPE ratio and if the CAPE ratio was able to identify under or overpriced markets and whether it would have generated excess returns. But the results show that since there were no excess returns, it means that market were efficient all the time. In other words, market was not significantly under priced or significantly overpriced.

Another contribution is the potential advancement in the methodological aspects as this study identified a unique way of testing the signalling ability of the CAPE ratio. As the study adopted methodology in analysing the efficiency of financial markets by testing the performance of the asset pricing models in subsamples built on the CAPE ratio valuation of the market trends. Also, the research results also contributed to advancement of the body of literature by providing new insight in the performance of the mainstream asset pricing models during different market valuations and subsamples.

The findings of the study have important implications for assisting both financial market participants and policymakers to make more accurate judgements about the efficiency of the financial markets in different market sentiments. This study also analysed the scope and capabilities of the CAPE ratio for investors whereby if using the CAPE ratio signals in their trading strategies would generate excess returns and the results show that including the CAPE ratio signals in trading strategies is not showing any improvements in the profits because the active trading strategy is not better than the returns from the buy and hold passive trading strategy. Also, testing the performance of CAPM, covered in chapter five, in time periods which have been highlighted by the CAPE ratio as under priced, overpriced and fairly priced and linking it to the market efficiency is another contribution. This offers a new prospective on the characteristics of this highly used model in practice during different market trends. The results show that stock returns will be more in line to the systematic risk when the CAPE ratio indicates a fairly priced market as the beta coefficient size was highest during that market phase. The lowest link between stock returns and systematic risk is observed in the overpriced phase. Moreover, practitioners may relay on the CAPM in analysing the market when the CAPE ratio signals a fairly priced situation as all the portfolios alpha in that period where insignificant and all the betas where significant.

Examining the performance of the Fama and French three factors model on the time periods which have been highlighted by the CAPE ratio as under priced, overpriced and fairly priced and then looking at the results of these models to get inferences about the risk and return relationships leads to test the general concept of market efficiency. It proposes a new prospective on the characteristics of this widely used model in academia during different market trends. For practitioners intending to use this model, they may get more risk adjusted returns in the overpriced CAPE level as all the portfolios alphas are insignificant and most of the factors are significant.

One of the main responsibilities of central banks and financial market regulators is to save the markets from overheating and eventually resulting in a sharp correction. It was believed that regulators can monitor the CAPE ratio and could intervene before a bubble develops in asset pricing. The findings of this study cast doubt on the usefulness of the CAPE ratio for regulators as the CAPE ratio may not give clear signals. The CAPE ratio remained in the bubble zone for long time periods without any correction in the market. This could be due to other factors supporting the market like excessive levels of quantitative easing. As the CAPE ratio based trading strategies did not produce enough arbitrage like opportunities, this can provide some indicators to policy makers that markets are efficient. Improving the liquidity of the financial markets is another objective of regulators. The results of this study show that even if CAPE ratio gives correct signals about market under pricing, there would not be many such signals and resulting trades and hence cannot contribute marginally towards improving the liquidity of the market. Furthermore, these research findings are of relevance to contemporary finance debates as the examined dataset included one of the recent longest periods of stock market booms 2001-2007 and the worst economic recessions since the Great Depression 2008-2009.

As with any research study, time constraints, data construction and lockdowns due to COVID-19 leads to several limitations in the present thesis. There have been several extensions offered by the presented work in this thesis with reference to the CAPE ratio to determine the potential use of the ratio in investing and hence testing the Efficient Market Hypothesis in the London Stock Exchange. Even though some of these applications appear promising, there is certainly room for improvement. Specially, the following limitations are the main ones.

Since this thesis focuses mainly on analysing the CAPE ratio and the asset pricing models in the London Stock Exchange market, this thesis has some limitations due to the issues of missing data and the lack of data availability. As a result of the limited number of stocks included and the short sample period of this thesis due to the data availability may adversely affect the significance of the tests. Additionally, the lack of historical data availability in the databases precludes some of the tests to be undertaken and had to rely on secondary data sources. The absence of a simple registry for historical price to earnings for the FTSE100 starting from 1988 made constructing the CAPE ratio very challenging.

The main finding of this thesis is that the Fama and French Three Factors Model is the most suitable asset pricing model for the London Stock Exchange market. Mckenzie and Partington (2014) argue that this assumption may be contested based on the empirical evidence documenting the shortcomings of Fama and French's Three Factors Model. This in turn may lead to invalid and confusing inferences given the sufficient empirical evidence supporting the limitations of the model. It might be worthwhile to test whether alternative asset pricing models can explain the variations in stock returns in the London Stock Exchange market better. Promising models that maybe considered are the four-factor model of Fama, French and Carhart Carhart (1997), the five factor model of Fama and French (2015), and the liquidity factor of Pastor and Stambaugh (2003) augmented with the Fama and French model.

Following Griffin's (2002) recommendation that country-specific risk factors should be used when calculating cost-of-capital, measuring performance, and analysing risk, which is debated for long in asset pricing literature, this thesis assumes that the UK version of the Fama and French factors are the most appropriate risk factors. Yet, as Harvey (2001) points out, it is highly debatable that markets are fully segmented, as it is observed that in the late 1980s many markets liberalized. In that context, a major feature of Harvey's (1998) analysis is that the importance of local risk factors compared to global ones changes over time with the integration between financial markets. Based on this observation, the London Stock Exchange market maybe impacted by global risk factors. Another limitation of this thesis is that it does not fully address to the impact of these global risk factors and this simplification is a common feature in many other studies in asset pricing.

In testing the Fama and French Three Factors Model, the six portfolios similar to the six factor’s portfolios of Fama and French (1993) have been used. Other studies have used the

25 portfolios instead. This can be considered as a limitation in this thesis. Similarly, this thesis makes use of realized returns as an indicator of expected returns, as has been done in earlier asset pricing literature. In his critique of this approach, Elton (1999) argues that it may be contributing to anomalous results in asset pricing models. A common limitation in most of the empirical work in the asset pricing literature relates to finding an appropriate proxy for expected returns.

Further research is essential to expand the research domain. Here, future research related to this study will be suggested that would help delve into the subject. Future studies could further explore and replicate this study into other developed and emerging markets. Such results could re-evaluate this study’s findings and may strengthen (weaken) its arguments. This will enrich that body of knowledge by providing fresh prospective to the asset pricing model literature.

In this study two sets of different portfolios were used in analysing the CAPM and the Fama and French three factors model. Future studies may consider using similar portfolios with both asset pricing models. This would provide a better comparison between the performance of those asset pricing models in the different CAPE ratio subsamples.

Further research may explore to test using the CAPE ratio with only an over and under priced signals by eliminating the fairly priced area and relaying on the CAPE ratio mean as a breakpoint between the over and under priced signal. This method was used in studies like Keimling (2016). This is an ideal further research approach. It can increase the length of the overpriced and under priced subsamples. Additionally, it could yield a higher return in the active investment strategy built on the CAPE ratio signals.

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Appendix A

Table A.1 The active trading return calculations

Date	FTSE100 CAPE Ratio	Market Return	Risk Free Return	Return	Return used	
					Market	Risk Free
31/12/2017	16.41	0.04770284	0.00022503	0.04770284	√	
30/11/2017	15.57	-0.0165613	0.00029171	-0.0165613	√	
31/10/2017	15.89	0.01867219	0.00030005	0.01867219	√	
30/09/2017	15.59	-0.0042908	0.00018335	-0.0042908	√	
31/08/2017	15.6	0.01389566	0.00014168	0.01389566	√	
31/07/2017	15.46	0.01166754	0.00010834	0.01166754	√	
30/06/2017	15.22	-0.0246901	0.00010834	-0.0246901	√	
31/05/2017	15.53	0.04362476	5.0001E-05	0.04362476	√	
30/04/2017	14.83	-0.0036932	5.8335E-05	-0.0036932	√	
31/03/2017	15.03	0.01227472	5.0001E-05	0.01227472	√	
28/02/2017	14.87	0.03107299	2.5E-05	0.03107299	√	
31/01/2017	14.56	-0.0032946	0.00013334	-0.0032946	√	
31/12/2016	14.49	0.05011533	8.33E-06	0.05011533	√	
30/11/2016	13.75	-0.0162663	0.00010001	-0.0162663	√	
31/10/2016	14.03	0.00561571	0.00013334	0.00561571	√	
30/09/2016	13.84	0.01694191	0.00015001	0.01694191	√	
31/08/2016	13.53	0.01897783	0.00018335	0.01897783	√	
31/07/2016	13.36	0.04008246	0.00028337	0.04008246	√	
30/06/2016	12.84	0.02819003	0.00030838	0.02819003	√	
31/05/2016	12.24	0.00682317	0.00035006	0.00682317	√	
30/04/2016	12.22	0.01136409	0.00036673	0.01136409	√	
31/03/2016	12.01	0.01938551	0.00037507	0.01938551	√	
29/02/2016	11.84	0.00803209	0.00039174	0.00803209	√	
31/01/2016	11.78	-0.0308152	0.00040008	-0.0308152	√	
31/12/2015	11.97	-0.0127184	0.00039174	-0.0127184	√	
30/11/2015	12.16	0.00571628	0.00040008	0.00571628	√	
31/10/2015	12.14	0.04696971	0.00040008	0.04696971	√	
30/09/2015	11.56	-0.0273199	0.00039174	-0.0273199	√	
31/08/2015	11.88	-0.0532309	0.00037507	-0.0532309	√	
31/07/2015	12.74	0.02398308	0.00040008	0.02398308	√	
30/06/2015	12.37	-0.0574818	0.00040842	-0.0574818	√	
31/05/2015	13.26	0.01349018	0.00038341	0.01349018	√	
30/04/2015	13.25	0.03035149	0.00035006	0.03035149	√	

31/03/2015	12.91	-0.0166597	0.00036673	-0.0166597	√	
28/02/2015	13.26	0.03727803	0.00033339	0.03727803	√	
31/01/2015	12.91	0.02623832	0.00028337	0.02623832	√	
31/12/2014	12.47	-0.0159711	0.00032505	-0.0159711	√	
30/11/2014	12.77	0.02921873	0.00034173	0.02921873	√	
31/10/2014	12.4	-0.0068762	0.00032505	-0.0068762	√	
30/09/2014	12.56	-0.0277089	0.00040008	-0.0277089	√	
31/08/2014	12.97	0.02152846	0.00033339	0.02152846	√	
31/07/2014	12.86	-0.0029955	0.00034173	-0.0029955	√	
30/06/2014	12.87	-0.0128172	0.00035006	-0.0128172	√	
31/05/2014	13.12	0.0136929	0.00023336	0.0136929	√	
30/04/2014	13.01	0.02163062	0.00028337	0.02163062	√	
31/03/2014	12.74	-0.0260546	0.00035006	-0.0260546	√	
28/02/2014	13.21	0.05242813	0.00031672	0.05242813	√	
31/01/2014	12.73	-0.0305244	0.00030005	-0.0305244	√	
31/12/2013	13.15	0.01836663	0.00021669	0.01836663	√	
30/11/2013	13.04	-0.0069756	0.0002417	-0.0069756	√	
31/10/2013	13.25	0.04289448	0.0002667	0.04289448	√	
30/09/2013	12.74	0.01116183	0.00029171	0.01116183	√	
31/08/2013	12.72	-0.022151	0.00022503	-0.022151	√	
31/07/2013	13.21	0.06779951	0.00025003	0.06779951	√	
30/06/2013	12.44	-0.0499114	0.00027504	-0.0499114	√	
31/05/2013	13.19	0.02911581	0.00025837	0.02911581	√	
30/04/2013	12.95	0.00581685	0.00027504	0.00581685	√	
31/03/2013	12.97	0.01409846	0.00030838	0.01409846	√	
28/02/2013	12.94	0.02275503	0.00027504	0.02275503	√	
31/01/2013	12.9	0.06374957	0.0002417	0.06374957	√	
31/12/2012	12.11	0.00984818	0.00025837	0.00984818	√	
30/11/2012	12.14	0.01755226	0.00019169	0.01755226	√	
31/10/2012	12.04	0.01035323	0.00019169	0.01035323	√	
30/09/2012	12.07	0.01085853	0.00021669	0.01085853	√	
31/08/2012	12.1	0.02214157	0.00020002	0.02214157	√	
31/07/2012	12.05	0.0132875	0.00021669	0.0132875	√	
30/06/2012	11.98	0.04822683	0.00029171	0.04822683	√	
31/05/2012	11.44	-0.0679791	0.00027504	-0.0679791	√	
30/04/2012	12.39	-0.0032946	0.00033339	-0.0032946	√	
31/03/2012	12.59	-0.009455	0.00036673	-0.009455	√	
29/02/2012	12.93	0.04289448	0.00033339	0.04289448	√	
31/01/2012	12.64	0.02716235	0.00030005	0.02716235	√	
31/12/2011	12.39	0.00843538	0.00020002	0.00843538	√	
30/11/2011	12.35	-0.0036932	0.00034173	-0.0036932	√	
31/10/2011	12.51	0.07896257	0.00038341	0.07896257	√	

30/09/2011	11.63	-0.0501014	0.00038341	-0.0501014	√	
31/08/2011	12.38	-0.0689106	0.00038341	-0.0689106	√	
31/07/2011	13.49	-0.0220532	0.00040842	-0.0220532	√	
30/06/2011	13.86	-0.0044899	0.00042509	-0.0044899	√	
31/05/2011	14	-0.0071741	0.00043343	-0.0071741	√	
30/04/2011	14.27	0.03107299	0.00046678	0.03107299	√	
31/03/2011	14.09	-0.0080673	0.00046678	-0.0080673	√	
28/02/2011	14.35	0.02398308	0.0004501	0.02398308	√	
31/01/2011	14.2	-0.005286	0.00042509	-0.005286	√	
31/12/2010	14.35	0.07143621	0.00041675	0.07143621	√	
30/11/2010	13.62	-0.022542	0.00040008	-0.022542	√	
31/10/2010	14.08	0.02531512	0.00041675	0.02531512	√	
30/09/2010	13.82	0.06545294	0.00040842	0.06545294	√	
31/08/2010	13.04	-0.0021976	0.00040842	-0.0021976	√	
31/07/2010	13.22	0.06897474	0.00041675	0.06897474	√	
30/06/2010	12.35	-0.0462942	0.00040842	-0.0462942	√	
31/05/2010	13.08	-0.0622764	0.00040842	-0.0622764	√	
30/04/2010	14.07	-0.0139025	0.00041675	-0.0139025	√	
31/03/2010	14.5	0.06758597	0.00042509	0.06758597	√	
28/02/2010	13.77	0.03375727	0.00040842	0.03375727	√	
31/01/2010	13.43	-0.0357455	0.00040842	-0.0357455	√	
31/12/2009	13.98	0.04341606	0.00040842	0.04341606	√	
30/11/2009	13.49	0.0296305	0.00038341	0.0296305	√	
31/10/2009	13.17	-0.0182318	0.00037507	-0.0182318	√	
30/09/2009	13.42	0.04717912	0.00032505	0.04717912	√	
31/08/2009	12.86	0.07702219	0.00030838	0.07702219	√	
31/07/2009	12.13	0.08502171	0.0003584	0.08502171	√	
30/06/2009	11.21	-0.0320743	0.00040842	-0.0320743	√	
31/05/2009	11.74	0.0419563	0.00043343	0.0419563	√	
30/04/2009	11.37	0.09943895	0.00048345	0.09943895	√	
31/03/2009	10.59	0.03282731	0.0005168	0.03282731	√	
28/02/2009	10.4	-0.0651788	0.00055015	-0.0651788	√	
31/01/2009	11.41	-0.0583296	0.00075028	-0.0583296	√	
31/12/2008	12.16	0.03675952	0.00097548	0.03675952	√	
30/11/2008	11.77	-0.0166597	0.00139264	-0.0166597	√	
31/10/2008	12.05	-0.1190021	0.00290421	-0.1190021	√	
30/09/2008	13.53	-0.1323787	0.00368176	-0.1323787	√	
31/08/2008	15.69	0.04990533	0.00402474	0.04990533	√	
31/07/2008	15.23	-0.0360347	0.00413352	-0.0360347	√	
30/06/2008	15.88	-0.070678	0.00415862	-0.070678	√	
31/05/2008	17.29	-0.001998	0.00410842	-0.001998	√	

30/04/2008	17.59	0.06258009	0.00399128	0.06258009	√	
31/03/2008	16.68	-0.0205852	0.00389088	-0.0205852	√	
29/02/2008	17.38	0.00772972	0.00405821	0.00772972	√	
31/01/2008	17.58	-0.086617	0.00411678	-0.086617	√	
31/12/2007	19.28	0.00260338	0.00426741	0.00260338	√	
30/11/2007	19.44	-0.0474379	0.00442643	-0.0474379	√	
31/10/2007	20.48	0.04341606	0.00452688	0.04341606	√	
30/09/2007	19.92	0.01887594	0.004552	0.01887594	√	
31/08/2007	19.55	-0.0026964	0.00468594	-0.0026964	√	
31/07/2007	19.92	-0.0332352	0.0046692	-0.0332352	√	
30/06/2007	20.68	-0.0075712	0.00468594	-0.0075712	√	
31/05/2007	20.9	0.02819003	0.00452688	0.02819003	√	
30/04/2007	20.53	0.0244952	0.00445155	0.0244952	√	
31/03/2007	20.23	0.03344719	0.00437621	0.03344719	√	
28/02/2007	20	-0.0016986	0.004326	-0.0016986	√	
31/01/2007	20.26	-0.0024969	0.00436784	-0.0024969	√	
31/12/2006	20.22	0.03334385	0.00415862	0.03334385	√	
30/11/2006	19.87	-0.0028958	0.00408331	-0.0028958	√	
31/10/2006	20.28	0.03035149	0.00405821	0.03035149	√	
30/09/2006	19.85	0.01572231	0.00396618	0.01572231	√	
31/08/2006	19.8	0.00712526	0.00389088	0.00712526	√	
31/07/2006	20.08	0.01318618	0.00381559	0.01318618	√	
30/06/2006	19.83	0.02009932	0.00370685	0.02009932	√	
31/05/2006	19.6	-0.0478189	0.00368176	-0.0478189	√	
30/04/2006	20.85	0.01065638	0.00363158	0.01065638	√	
31/03/2006	20.88	0.03790058	0.00360649	0.03790058	√	
28/02/2006	20.41	0.01207229	0.0035814	0.01207229	√	
31/01/2006	20.48	0.02911581	0.00359812	0.02911581	√	
31/12/2005	19.96	0.03935466	0.00361485	0.03935466	√	
30/11/2005	19.38	0.03303389	0.00359812	0.03303389	√	
31/10/2005	19.08	-0.0288749	0.00361485	-0.0288749	√	
30/09/2005	19.75	0.03417085	0.00359812	0.03417085	√	
31/08/2005	19.22	0.01166754	0.0035814	0.01166754	√	
31/07/2005	19.29	0.03386065	0.00362321	0.03386065	√	
30/06/2005	18.75	0.03396404	0.00377377	0.03396404	√	
31/05/2005	18.26	0.0390429	0.00379886	0.0390429	√	
30/04/2005	17.74	-0.022542	0.00383232	-0.022542	√	
31/03/2005	18.26	-0.0087614	0.00388252	-0.0087614	√	

28/02/2005	18.67	0.02593049	0.00388252	0.02593049	√	
31/01/2005	18.34	0.0132875	0.00379886	0.0132875	√	
31/12/2004	18.15	0.02911581	0.00382396	0.02911581	√	
30/11/2004	17.89	0.02398308	0.0037905	0.02398308	√	
31/10/2004	17.64	0.01227472	0.00381559	0.01227472	√	
30/09/2004	17.52	0.02777883	0.00383232	0.02777883	√	
31/08/2004	17.14	0.01653522	0.00385742	0.01653522	√	
31/07/2004	17.03	-0.0153805	0.00384906	-0.0153805	√	
30/06/2004	17.19	0.0147071	0.00377377	0.0147071	√	
31/05/2004	17.07	-0.0132119	0.00363158	-0.0132119	√	
30/04/2004	17.35	0.0206095	0.00345596	0.0206095	√	
31/03/2004	17.02	-0.0132119	0.00341415	-0.0132119	√	
29/02/2004	17.46	0.02860138	0.00329709	0.02860138	√	
31/01/2004	17.11	-0.0086623	0.00323857	-0.0086623	√	
31/12/2003	17.35	0.02921873	0.00316333	0.02921873	√	
30/11/2003	16.89	0.01288227	0.00312989	0.01288227	√	
31/10/2003	16.64	0.04948546	0.00309645	0.04948546	√	
30/09/2003	15.9	-0.0159711	0.00288749	-0.0159711	√	
31/08/2003	16.23	0.01562075	0.00287078	0.01562075	√	
31/07/2003	16.27	0.0394586	0.00266187	0.0394586	√	
30/06/2003	15.75	0.00310481	0.00284571	0.00310481	√	
31/05/2003	15.78	0.04383351	0.00279557	0.04383351	√	
30/04/2003	15.3	0.0937367	0.00282899	0.0937367	√	
31/03/2003	14.1	-0.0061808	0.00285407	-0.0061808	√	
28/02/2003	14.31	0.02623832	0.00283735	0.02623832	√	
31/01/2003	14	-0.0897172	0.00307973	-0.0897172	√	
31/12/2002	15.34	-0.0534202	0.00314661	-0.0534202	√	
30/11/2002	16.27	0.03541261	0.00313825	0.03541261	√	
31/10/2002	15.74	0.07788415	0.00309645	0.07788415	√	
30/09/2002	14.49	-0.1175913	0.00308809	-0.1175913	√	
31/08/2002	16.48	0.00330545	0.00312989	0.00330545	√	
31/07/2002	16.58	-0.0922625	0.00327201	-0.0922625	√	
30/06/2002	18.1	-0.0842391	0.00322185	-0.0842391	√	
31/05/2002	19.75	-0.0122247	0.00341415	-0.0122247	√	
30/04/2002	20.09	-0.0155774	0.00325529	-0.0155774	√	
31/03/2002	20.57	0.0419563	0.00327201	0.0419563	√	
28/02/2002	19.96	-0.0080673	0.00321349	-0.0080673	√	
31/01/2002	20.22	-0.0104451	0.00315497	-0.0104451	√	

31/12/2001	20.35	0.00451014	0.00313825	0.00451014	√	
30/11/2001	20.35	0.04362476	0.00308809	0.04362476	√	
31/10/2001	19.68	0.03241426	0.00336398	0.03241426	√	
30/09/2001	19.11	-0.0942573	0.00348941	-0.0942573	√	
31/08/2001	20.89	-0.0233237	0.00313825	-0.0233237	√	
31/07/2001	21.71	-0.0227375	0.00405821	-0.0227375	√	
30/06/2001	22.01	-0.0281949	0.00410005	-0.0281949	√	
31/05/2001	22.66	-0.0180354	0.00403311	-0.0180354	√	
30/04/2001	23.53	0.06045705	0.00418373	0.06045705	√	
31/03/2001	22.37	-0.0505762	0.00418373	-0.0505762	√	
28/02/2001	23.62	-0.0507661	0.00438458	-0.0507661	√	
31/01/2001	25.18	0.01612869	0.00446829	0.00446829		√
31/12/2000	24.7	0.01491006	0.00456037	0.01491006	√	
30/11/2000	24.4	-0.041897	0.00459385	-0.041897	√	
31/10/2000	25.63	0.01714532	0.00471106	0.00471106		√
30/09/2000	25.05	-0.0542717	0.00471106	0.00471106		√
31/08/2000	26.76	0.05179687	0.00478642	0.00478642		√
31/07/2000	25.52	0.0118699	0.00474455	0.00474455		√
30/06/2000	25.13	0.00531407	0.00474455	0.00474455		√
31/05/2000	25.31	0.00682317	0.00475293	0.00475293		√
30/04/2000	25.22	-0.0328484	0.00483666	0.00483666		√
31/03/2000	26.12	0.04425112	0.00474455	0.00474455		√
29/02/2000	24.87	0.00692386	0.00474455	0.00692386		√
31/01/2000	25.08	-0.0815796	0.00465246	0.00465246		√
31/12/1999	27.42	0.05169169	0.00456037	0.00456037		√
30/11/1999	26.13	0.06428158	0.00430089	0.00430089		√
31/10/1999	24.35	0.02860138	0.00425904	0.02860138		√
30/09/1999	23.8	-0.0366129	0.0042172	-0.0366129	√	
31/08/1999	24.71	0.00883883	0.00394945	0.00883883	√	
31/07/1999	24.66	-0.0063796	0.00395781	-0.0063796	√	
30/06/1999	24.81	0.02142632	0.00384069	0.02142632	√	
31/05/1999	24.35	-0.0443848	0.00402474	-0.0443848	√	
30/04/1999	25.64	0.04843649	0.00399964	0.00399964		√
31/03/1999	24.69	0.0308668	0.00399128	0.0308668	√	
28/02/1999	24.33	0.04969537	0.00408331	0.04969537	√	
31/01/1999	23.26	0.00863709	0.00427578	0.00863709	√	
31/12/1998	23.06	0.01918165	0.00454362	0.01918165	√	

Appendix B

Table B.1 The Residuals Statistics in the Full Sample

		Minimum	Maximum	Mean	Std. Deviation
P1	Predicted Value	-0.105376	0.087544	0.0091457	0.032297
	Residual	-0.117110	0.148521	0.0000000	0.028081
	Std. Predicted Value	-3.546	2.427	0.000	1
	Std. Residual	-4.161	5.277	0.000	0.998
P2	Predicted Value	-0.124211	0.097384	0.0073331	0.037098
	Residual	-0.076409	0.108902	0.0000000	0.022041
	Std. Predicted Value	-3.546	2.427	0.000	1
	Std. Residual	-3.459	4.930	0.000	0.998
P3	Predicted Value	-0.133441	0.102373	0.0065434	0.039478
	Residual	-0.053683	0.057429	0.0000000	0.016046
	Std. Predicted Value	-3.546	2.427	0.000	1
	Std. Residual	-3.338	3.571	0.000	0.998
P4	Predicted Value	-0.139954	0.109835	0.0083263	0.041818
	Residual	-0.103208	0.123450	0.0000000	0.024500
	Std. Predicted Value	-3.546	2.427	0.000	1
	Std. Residual	-4.203	5.028	0.000	0.998
P5	Predicted Value	-0.144025	0.116582	0.0106770	0.043629
	Residual	-0.116580	0.136256	0.0000000	0.028759
	Std. Predicted Value	-3.546	2.427	0.000	1
	Std. Residual	-4.045	4.728	0.000	0.998

Table B.2 The Residuals Statistics in the Subsample 1

		Minimum	Maximum	Mean	Std. Deviation
P1	Predicted Value	-0.118958	0.091627	0.0088311	0.036769
	Residual	-0.104593	0.144438	0.0000000	0.026847
	Std. Predicted Value	-3.475	2.252	0.000	1
	Std. Residual	-3.877	5.353	0.000	0.995
P2	Predicted Value	-0.125244	0.096448	0.0092850	0.038709
	Residual	-0.075382	0.109838	0.0000000	0.020814
	Std. Predicted Value	-3.475	2.252	0.000	1
	Std. Residual	-3.604	5.251	0.000	0.995
P3	Predicted Value	-0.134697	0.102513	0.0092485	0.041418
	Residual	-0.040174	0.057289	0.0000000	0.015224
	Std. Predicted Value	-3.475	2.252	0.000	1
	Std. Residual	-2.626	3.745	0.000	0.995
P4	Predicted Value	-0.145935	0.112274	0.0107533	0.045085
	Residual	-0.103100	0.121011	0.0000000	0.025062
	Std. Predicted Value	-3.475	2.252	0.000	1
	Std. Residual	-4.093	4.805	0.000	0.995
P5	Predicted Value	-0.157224	0.124932	0.0139960	0.049266
	Residual	-0.118413	0.127905	0.0000000	0.029534
	Std. Predicted Value	-3.475	2.252	0.000	1
	Std. Residual	-3.990	4.309	0.000	0.995

Table B.3 The Residuals Statistics in the Subsample 2

		Minimum	Maximum	Mean	Std. Deviation
P1	Predicted Value	-0.014106	0.055266	0.0271434	0.019863
	Residual	-0.075382	0.078484	0.0000000	0.046931
	Std. Predicted Value	-2.077	1.416	0.000	1
	Std. Residual	-1.548	1.612	0.000	0.964
P2	Predicted Value	-0.046402	0.052950	0.0126744	0.028447
	Residual	-0.052284	0.054073	0.0000000	0.026886
	Std. Predicted Value	-2.077	1.416	0.000	1
	Std. Residual	-1.874	1.938	0.000	0.964
P3	Predicted Value	-0.057547	0.056732	0.0104053	0.032721
	Residual	-0.033805	0.041919	0.0000000	0.020737
	Std. Predicted Value	-2.077	1.416	0.000	1
	Std. Residual	-1.571	1.948	0.000	0.964
P4	Predicted Value	-0.054021	0.061259	0.0145264	0.033008
	Residual	-0.033399	0.047439	0.0000000	0.021927
	Std. Predicted Value	-2.077	1.416	0.000	1
	Std. Residual	-1.468	2.085	0.000	0.964
P5	Predicted Value	-0.054672	0.052879	0.0092796	0.030794
	Residual	-0.045269	0.035741	0.0000000	0.023024
	Std. Predicted Value	-2.077	1.416	0.000	1
	Std. Residual	-1.895	1.496	0.000	0.964

Table B.4 The Residuals Statistics in the Subsample 3

		Minimum	Maximum	Mean	Std. Deviation
P1	Predicted Value	-0.076274	0.085666	0.0110771	0.027363
	Residual	-0.038614	0.067061	0.0000000	0.022115
	Std. Predicted Value	-3.192	2.726	0.000	1
	Std. Residual	-1.732	3.009	0.000	0.992
P2	Predicted Value	-0.091110	0.097051	0.0103854	0.031793
	Residual	-0.051159	0.042775	0.0000000	0.019451
	Std. Predicted Value	-3.192	2.726	0.000	1
	Std. Residual	-2.610	2.182	0.000	0.992
P3	Predicted Value	-0.095193	0.097688	0.0088480	0.032591
	Residual	-0.029228	0.030012	0.0000000	0.013191
	Std. Predicted Value	-3.192	2.726	0.000	1
	Std. Residual	-2.198	2.257	0.000	0.992
P4	Predicted Value	-0.107557	0.109087	0.0093025	0.036606
	Residual	-0.060068	0.048051	0.0000000	0.021874
	Std. Predicted Value	-3.192	2.726	0.000	1
	Std. Residual	-2.725	2.180	0.000	0.992
P5	Predicted Value	-0.102972	0.110309	0.0120730	0.036038
	Residual	-0.071762	0.093876	0.0000000	0.024361
	Std. Predicted Value	-3.192	2.726	0.000	1
	Std. Residual	-2.923	3.823	0.000	0.992

Appendix C

Table C.1 The Residuals Statistics in the full sample

		Minimum	Maximum	Mean	Std. Deviation
SL	Predicted Value	-0.286468	0.206441	0.0056666	0.054473
	Residual	-0.083886	0.061356	0.0000000	0.016030
	Std. Predicted Value	-5.363	3.686	0.000	1
	Std. Residual	-5.215	3.815	0.000	0.997
SM	Predicted Value	-0.219259	0.227813	0.0075746	0.047663
	Residual	-0.045727	0.043330	0.0000000	0.012574
	Std. Predicted Value	-4.759	4.621	0.000	1
	Std. Residual	-3.624	3.434	0.000	0.997
SH	Predicted Value	-0.242762	0.260255	0.0086839	0.050934
	Residual	-0.040294	0.054764	0.0000000	0.011487
	Std. Predicted Value	-4.937	4.939	0.000	1
	Std. Residual	-3.496	4.751	0.000	0.997
BL	Predicted Value	-0.278911	0.128135	0.0049438	0.041944
	Residual	-0.045946	0.061400	0.0000000	0.013525
	Std. Predicted Value	-6.767	2.937	0.000	1
	Std. Residual	-3.386	4.524	0.000	0.997
BM	Predicted Value	-0.278504	0.140265	0.0053228	0.045194
	Residual	-0.074007	0.086853	0.0000000	0.017282
	Std. Predicted Value	-6.280	2.986	0.000	1
	Std. Residual	-4.268	5.009	0.000	0.997
BH	Predicted Value	-0.229551	0.135512	0.0077041	0.047371
	Residual	-0.088533	0.058331	0.000	0.016318
	Std. Predicted Value	-5.008	2.698	0.000	1
	Std. Residual	-5.407	3.563	0.000	0.997

Table C.2 The Residuals Statistics in the subsample 1

		Minimum	Maximum	Mean	Std. Deviation
SL	Predicted Value	-0.170401	0.179757	0.0106854	0.043965
	Residual	-0.035001	0.059863	0.0000000	0.015667
	Std. Predicted Value	-4.119	3.846	0.000	1
	Std. Residual	-2.201	3.764	0.000	0.985
SM	Predicted Value	-0.1974498	0.21656	0.0115137	0.048633
	Residual	-0.0273900	0.03201	0.0000000	0.011903
	Std. Predicted Value	-4.297	4.216	0.000	1
	Std. Residual	-2.267	2.649	0.000	0.985
SH	Predicted Value	-0.2481053	0.263303	0.0088258	0.059841
	Residual	-0.0353867	0.036159	0.0000000	0.012366
	Std. Predicted Value	-4.294	4.253	0.000	1
	Std. Residual	-2.819	2.880	0.000	0.985
BL	Predicted Value	-0.098154	0.064315	0.0093415	0.032174
	Residual	-0.033343	0.041991	0.0000000	0.012246
	Std. Predicted Value	-3.341	1.709	0.000	1
	Std. Residual	-2.682	3.378	0.000	0.985
BM	Predicted Value	-0.149707	0.093002	0.0075374	0.045397
	Residual	-0.064276	0.079510	0.0000000	0.019182
	Std. Predicted Value	-3.464	1.883	0.000	1
	Std. Residual	-3.301	4.083	0.000	0.985
BH	Predicted Value	-0.131335	0.115046	0.0064476	0.045628
	Residual	-0.033853	0.039854	0.000	0.01373
	Std. Predicted Value	-3.020	2.380	0.000	1
	Std. Residual	-2.429	2.859	0.000	0.985

Table C.3 The Residuals Statistics in the subsample 2

		Minimum	Maximum	Mean	Std. Deviation
SL	Predicted Value	-0.173612	0.257300	0.0108828	0.128521
	Residual	-0.050376	0.052972	0.0000000	0.023234
	Std. Predicted Value	-1.436	1.917	0.000	1
	Std. Residual	-1.922	2.021	0.000	0.886
SM	Predicted Value	-0.0515055	0.05192	0.0051964	0.030843
	Residual	-0.0198078	0.02667	0.0000000	0.015348
	Std. Predicted Value	-1.838	1.515	0.000	1
	Std. Residual	-1.144	1.540	0.000	0.886
SH	Predicted Value	-0.0462026	0.065198	0.0137384	0.032278
	Residual	-0.0170964	0.015664	0.0000000	0.009907
	Std. Predicted Value	-1.857	1.594	0.000	1
	Std. Residual	-1.530	1.401	0.000	0.886
BL	Predicted Value	-0.0713219	0.086391	-0.000239	0.042082
	Residual	-0.0217769	0.016554	0.0000000	0.010757
	Std. Predicted Value	-1.689	2.059	0.000	1
	Std. Residual	-1.794	1.364	0.000	0.886
BM	Predicted Value	-0.1332707	0.0600272	-0.000311	0.055234
	Residual	-0.0269661	0.0266128	0.0000000	0.015950
	Std. Predicted Value	-2.407	1.092	0.000	1
	Std. Residual	-1.499	1.479	0.000	0.886
BH	Predicted Value	-0.1195327	0.1025791	0.00230882	0.051898
	Residual	-0.0614657	0.0614883	0.0000000	0.025877
	Std. Predicted Value	-2.348	1.932	0.000	1
	Std. Residual	-2.105	2.106	0.000	0.886

Table C.4 The Residuals Statistics in the subsample 3

		Minimum	Maximum	Mean	Std. Deviation
SL	Predicted Value	-0.1042657	0.113608	0.010136	0.041977
	Residual	-0.0247471	0.039136	0.0000000	0.011692
	Std. Predicted Value	-2.725	2.465	0.000	1
	Std. Residual	-2.066	3.268	0.000	0.976
SM	Predicted Value	-0.0999884	0.105888	0.012772	0.039404
	Residual	-0.0163931	0.026135	0.0000000	0.008988
	Std. Predicted Value	-2.862	2.363	0.000	1
	Std. Residual	-1.781	2.839	0.000	0.976
SH	Predicted Value	-0.1224609	0.1189697	0.009939	0.044241
	Residual	-0.0216806	0.0175086	0.0000000	0.008477
	Std. Predicted Value	-2.993	2.464	0.000	1
	Std. Residual	-2.497	2.017	0.000	0.976
BL	Predicted Value	-0.07639495	0.074119	0.0066932	0.023798
	Residual	-0.028301362	0.0343222	0.0000000	0.012322
	Std. Predicted Value	-3.491	2.833	0.000	1
	Std. Residual	-2.242	2.719	0.000	0.976
BM	Predicted Value	-0.093295634	0.0958246	0.011199	0.0318449
	Residual	-0.056927592	0.0446848	0.0000000	0.0208800
	Std. Predicted Value	-3.281	2.657	0.000	1
	Std. Residual	-2.662	2.089	0.000	0.976
BH	Predicted Value	-0.093924366	0.0832673	0.009036	0.03674466
	Residual	-0.023296621	0.0390254	0.0000000	0.0126868
	Std. Predicted Value	-2.8028	2.020	0.000	1
	Std. Residual	-1.793	3.003	0.000	0.976