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Declaration

I, Lenia Sithabiso Mukoyi, declare that this dissertation is entirely my own work and is not being submitted for degree purposes at any other university. It is my own work except for the assistance of all the resources used which is duly noted acknowledged, all work which is not my own is duly referenced by means of in-text citations and the bibliography section of this thesis.

Lenia Sithabiso Mukoyi

September 2019

Dedication

Dedication to my parents, Mrs. Ommah Mukoyi and late Mr. Willard Mukoyi and my family.

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Abstract

Market Segmentation and style investing have become an essential part of security management over the past 40 years. There are many factors that separate the market, these include economy, investor behaviours, and specific anomalies. Apart, from the segmentation, investors lean towards a few tested investment styles and sectors, which hinder growth, while, dividing the market further. Thus, a major question arises on what really drives asset performance in the South African equity market. An evaluation of the relationship between sector performance and style anomalies over time is essential. Howbeit, the topic of market anomalies tends to be controversial because the presence of market anomalies varies from sample to sample, this implies that it is difficult to generalize the effect of market anomalies on stock returns. Additionally, it has been shown that aftermarket anomalies are analysed and documented in academic literature, they often disappear, reverse or weaken. Thus, a study on this topic will give investors a broader view of different methods, which can be used to estimate expected returns, as no one model has been said to be accurate. Moreover, this study examined the relationship that exists between security returns and anomalies. The research further went on to investigate the relationship between style anomalies and security returns using the multifactor asset models. In addition to this, the study scrutinized the consistency of the inter-relationship being investigated before and after the 2008 global financial crisis. The key objective of this study was to examine the effects of market anomalies on the performance of securities on the resources, industrial and financial sectors of the JSE including the applicability of the Fama and French five-factor model.

This study made use of the Capital Asset Pricing model, the Fama and French three-factor model, the Carhart Four Factor model and the Fama and French Five-Factor model to investigate the effects of the style-based risk factors of the resources, industrials and financial sector returns of the JSE. Furthermore, this was done through the use of monthly observation from 2000 to 2016, with an additional split from 2000 to 2008 and 2009 to 2016 for the Carhart Four Factor Model and the Fama and French Five Factor Model. The study made use of monthly data that was extracted from IRESS (used to be INET), which consists of firm characteristics of all JSE tradable sector indices from financial statements between January 2000 to December 2016. The results discussion commenced with the stationarity and cointegration test results. These showed there is a long-run relationship between the variables based on the results of cointegration using the trace and eigenvalues. Thereafter, an analysis of the results of the cross-sector analysis where monthly stock returns was completed.

The CAPM served as the foundation of the multifactor asset pricing model used to test its predictive abilities in explaining returns used in this study. This was found to be limited in its ability to explain returns as it lacked the ability to capture abnormal returns Regardless of the academic debate, and for those with a longer view, the CAPM still seems to have something to offer, it provided a base for additional factors added thus, value and size through the Fama and French Three Factor Model the predictive power over the CAPM is shown be stronger in the financial sector when compared to the resources and the industrial sectors.

The financial sector shows the presence of the value and size (small cap) effect, while the resources sector shows some mild growth and size (small cap) effect presence. The industrial sector shows no value effect only some degree of moderate effects of size (small cap) can be inferred. When the Carhart Four Factor Model as analysed the CAPM performed better than the Carhart Four Factor Model in the industrial sector for the 6-month holding period momentum variables from 2000 to 2008, however, post-2008 the Carhart Four Factor Model outperforms. It is evident that i from 2000 to 2008 in the resources sector there was growth, size (small cap) and contrarian effects while in the financial sector there is the presence of value, size (small cap) and contrarian effect. However, in the industrial sector there is size (small cap) and it can be inferred that there is some mild growth and a mild contrarian effect. From the period between 2009 and 2009, the financial and industrial sectors show the presence of size (large-cap) and some mild large-cap effects. The model captures anomalies in all sectors mostly

in the financial sectors and resources sectors through the periods. One other finding that requires further exposition is the speed of adjustment that was insignificant for most of the estimated models but showed signs of returning to equilibrium when there is a shift in the model. This could be as a result of the data set, we used or the inherent structure of the South African economy.

These research results establish that a pattern exists in the results, where results differ across the JSE sectors and are affected by the variables inputted in the asset-pricing model used. These findings indicate that against the Carhart Four Factor Model and the Fama and French five factor model performs well but lacks the ability to fully explain anomaly effects as the operating profitability and investing factors. Furthermore, the study established that in the resources and industrial sectors the value anomaly may lose its predictive power when profitability and investment variables are included in the model. The question of whether anomalies can be explained with rational or behavioural explanations remains a vividly debated one. Based on our findings we have to conclude that investors are subject to biases. The Carhart Four Factor models seem to be a better model at explaining the effects of market anomalies. The results from this study show that several style-based risk factors are present across the three sectors and that there is a degree of market inefficiency in these sectors.

Specifically, in a bullish market, there is the presence of size and contrarian in all sector but there is growth in the resources sector while there is value in the financial sectors. However, in a bearish market, the financial sector has aspects such as value, momentum and aggressive investing factors, while in all the sectors there is a mild presence of large-cap bias, weak operating profitability and aggressive investing. Moreover, the results suggest that the industrial sector is the most efficient sector of the JSE, thus it would be difficult for investors to obtain above-average returns in this particular sector. Finally, the study showed that the Fama and French five factor model was applicable to the JSE from 2009; however, the value anomaly may lose its predictive power when profitability and investment are included in the model. It is evident that there is no standard asset pricing model that outperforms other asset pricing models for this study, however, it was established that when the market conditions start changing the predictive abilities of models also start changing. Overally, this study shows the Carhart Four Factor model is a better model at capturing effects of the market anomalies, especially in the financial sector. In conclusion, it may be worthwhile for researchers to look further into conditional asset pricing models, implying restricting or unrestricting certain variables in the model to determine if more useful results can be obtained. Overall, this study will add to the existing body of knowledge on the effect of market anomalies and stock returns in different sectors.

Keywords: asset pricing models, style risks, anomalies, momentum, profitability, investment, sector allocation, CAPM

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Abbreviations

ACF:	Auto-correlation function
ADF:	Augmented Dickey-Fuller
ALSI:	FTSE/JSE All Share Index
APT:	Arbitrage Pricing Theory
B/M:	Book-to-Market
CAPM:	Capital Asset Pricing Model
CH4FM:	Carhart Four-Factor Model
DF:	Dickey-Fuller
CMA:	Conservative Minus Aggressive
EMH:	Efficient Market Hypothesis
FF:	Fama and French
FF3FM:	Fama and French Three-Factor Model
FF5FM:	Fama and French Five-Factor Model
FTSE:	Financial Times-Stock Exchange
HML:	High minus low
JSE:	Johannesburg Stock Exchange
MOM12:	Previous 12 months' returns
MOM6:	Previous 6 months' returns
MPT:	Modern Portfolio Theory
OLS:	Ordinary least squares
RMW:	Robust Minus Weak
SARB:	South African Reserve Bank
SASM:	South African Stock Market
SMB:	Small minus Big
VAR:	Vector Autoregression Model
VECM:	Vector Error Correction Model

Glossary of Terms

S/N	Terminology	Definition
1.	**Abnormal return**	This is the difference between the expected return and the actual return of a security. This is the fraction of a security's or portfolio's return not explained by the rate of return of the market which can result from the investor's expertise. Also known as "alpha" or "excess return.
2.	**Arbitrage**	This refers to the simultaneous acquisition and sale of a security or asset to profit from a difference in the price.
3.	**Alpha**	This refers to a stock's expected return beyond that induced by the market index; it's expected an excess return when the market's excess return is zero
4.	**Asset**	This is a resource with economic value that an individual, corporation or country owns or controls with the expectation that it will provide future benefit. An asset can be seen as something that in the future can generate cash flow, reduce expenses, improve sales.
5.	**Asset Pricing Model**	This refers to a model for determining the required or expected rate of return on an asset at a given level of risk based on arbitrage or equilibrium theories. These models are reviewed from an empirical perspective, emphasizing the relationships among the various models.
6.	**Bear market**	This is when prices are declining substantially over time in the which depicts a bad economy, imminent recession, and falling stock prices.
7.	**Bull market**	This is a market with rising or expected rise of prices on securities characterized by investor confidence and expectations that strong results.
8.	**Capital Market**	This is a financial market in which market where financial securities like bonds, stocks are bought and sold.
9.	**Correlation**	This refers to a mutual relationship or connection between two or more financial variables over time. It is a statistic that measures the degree to which two securities move in relation to each other.
10.	**Covariance**	This is a measure of the degree to which returns on two risky assets move in tandem. A positive covariance means that asset returns move together, while a negative covariance means returns move inversely.
11	**Cross-sectional Test**	This is a type of analysis that an investor may conduct on a company in relation to that company's industry or industry peers. The analysis compares one company against the industry in which it operates, or directly against certain competitors within the same industry, in an attempt to assess performance and investment opportunities.
12	**Diversification**	means that many assets are held in the portfolio (allocating investments among various financial instruments, industries, and other categories) so that the risk exposure to any particular asset is limited and return is maximized.
13	**Equity**	refers to an ownership share of stock or any other security in a corporation.
14	**Expected Return**	is the profit or loss anticipated by an investor on a financial investment that has several known or anticipated rates of return across possible economic scenarios.
15	**Factor Model**	denotes a way of decomposing the forces that influence a security's rate of return into common and firm-specific influences.
16	**Firm-specific risk**	is risk that can be eliminated by diversification also known as non-systematic risk, diversifiable risk or unique risk.
17	**Investment**	is an asset or item that is purchased with the anticipation that it will generate income or gain profitable returns. In finance, an investment is a monetary asset purchased with the idea that the asset will provide income in the future or will be sold at a higher price for a profit.

18	**Investor**	is any person who commits capital with the expectation of financial returns. Investors utilize investments in order to grow their money and/or provide an income during retirement, such as with an annuity.
19	**Jensen Alpha or just "Alpha**	**",** is used to measure the risk-adjusted performance of a security or portfolio in relation to the expected market return (which is based on the capital asset pricing model).
20	**Market Anomaly or Market Inefficiency**	refers to a price or rate of return distortion on a financial market that seems contrary to the notion of efficient markets, where security prices are said to reflect all available information at any point in time.
21	**Market Efficiency**	refers to the degree to which stock prices and other securities prices reflect all available, relevant information, does not require that the market price be equal to the true value at every point in time.
22	**Market Index**	is a metric that tracks the performance of a group of stocks and/or the market's changes over time. Some indices are designed to indicate the overall performance of the market, while others follow a particular sector. It is an aggregate value produced by combining several stocks or other investment vehicles together and expressing their total values against a base value from a specific date.
23	**Market liquidity**	refers to the extent to which a market, such as a country's stock market allows assets to be bought and sold at stable prices without affecting the asset's price.
24	**Market Portfolio**	refers to a portfolio consisting of all assets available to investors, with each asset held in proportion to its market value relative to the total market value of all assets.
25	**Market Proxy**	is a broad representation of the overall market. The market proxy, once selected, is then used in performance evaluations and studies, or to test a hypothesis. A market proxy is a purely theoretical representation and cannot fully reflect the entire range of price movements for all market sectors. It may not actually be possible to find a true proxy of the market as a whole because a proxy will only represent a small part of the overall market for all risky assets.
26	**Market Sector Indices**	summarize the performance of stocks grouped by specific market sectors. This allows investors to benchmark the performance of a particular stock market sector or industry.
26	**Market Segmentation**	is the process of dividing a market of potential customers into groups, or segments, based on different characteristics. The segments created are composed of consumers who will respond similarly to marketing strategies and who share traits such as similar interests, needs, or locations.
27	**Multi-factor Model**	is a financial model that employs multiple factors in its computations to explain market phenomena and/or equilibrium asset prices. The multi-factor model can be used to explain either an individual security or a portfolio of securities.
28	**Rate of Return**	is the annual income on an investment over a specified time period, expressed as a percentage of the original investment's cos
29	**Required Rate of return**	is the minimum acceptable return on investment sought by individuals or companies considering an investment opportunity.
20	**Return**	is the gain or loss of a security in a particular period. The return consists of the income and the capital gains relative on investment, and it is usually quoted as a percentage.
31	**Risk**	is the uncertainty associated with any investment it implies deviation from expected earnings or expected outcome. Therefore, risk is the possibility that the actual return on an investment will be different from its expected return.
32	**Risk-return trade-off**	denotes assets with higher expected returns entail greater risk.
33	**Security analysis**	involves the valuation of particular securities that might be included in the portfolio.

34	**Single-factor model**	is a model of security returns that acknowledges only one common factor. The single factor is usually the market return.
35	**Stock Market or "equity market**"	refers to the collection of markets and exchanges where the issuing and trading of equities (stocks of publicly held companies as well as those only traded privately), bonds and other sorts of securities takes place, either through formal exchanges or over-the-counter markets. The stock market provides companies with access to capital in exchange for giving investors a slice of ownership.
36	**Stock**	also known as equity, represents ownership interests in corporations.
37	**Style Anomalies**	comprise patterns and relationships found in the cross-section of stock returns data, which contradict the existing asset-pricing models.
38	**Systematic Risk**	refers to risk factors common to the whole economy also known as market risk or no diversifiable risk.

Commonly Used Notations

Cov (ri, rj) covariance between returns on securities i and j
ei,t the firm-specific return, of security *i* in period ta
k market capitalization rate, the required rate of return on a firm's stock
M the market portfolio
P/E price-to-earnings multiple
r rate of return on a security
rf the risk-free rate of interest
rM the rate of return on the market portfolio
ROE return on equity
t time
β refers to the Beta of the assets
ai refers to Jensen's Alpha

CHAPTER ONE: INTRODUCTION

1.1. Background

Market segmentation and style investing have become an integral part of asset management. Security investors and financial practitioners pay attention to economic sector allocations, segments well-performing and investment style exposures before they make decisions. Investors make decisions on which assets to invest in, equities, foreign exchange or bonds, and at the same time, they have to decide if they want value, growth or capitalization on selected assets. Furthermore, they have to also consider the market performance, risk exposures and company-specific factors that influence returns. Potential investors have to choose which assets classes and/or industries to invest in the capital market. However, it is difficult to just jump and conclude that these are the only factors that cause segmentation in investment selection. Historically, it is difficult to actively manage the performance of segments because sectors do not perform similarly (Bernstein, 1995). Efficient Market Hypothesis (EMH) suggests that all information is available in the market, thus, current news is quickly assimilated into the price of securities which renders attempts to pick individual stocks and outperform the market useless (Fama, 1970). On the backdrop of EMH, investors manage to use the performance of economic sectors to determine where to place assets and diversify their portfolios. These sectors have unique characteristics and different risk profiles that attract investors. On a global or national level investors' expectations on returns differ depending on observed risk and economic conditions. Players in the equity markets have different views on some assets which will lead to different stock selection. Thus, some asset managers specialize in sectors when they invest such that in large research and investment firms some analysts invest in resources only.

Investors who specialize in sector investing search for the best performing sectors over a period of time. Economic sectors do not all perform well at the same time, so investors will try to gain exposure in multiple sectors through sector rotation. Some investors will try to profit through timing economic cycles and once a sector starts to struggle, they move to the rising. While others will attempt to profit through investment styles in specific sectors and stocks. The intention is to stay with sectors that are outperforming until they reach their peak, thus, asset managers tend to allocate more funds towards successful sectors and investment styles. Therefore, the factors that delaminate market segments vary based on the economic sectors and investment styles employed. Security managers tend to pay more attention to the underlying circumstances of companies than that of the macroeconomy. Thus, managers that pay more attention to style follow the individual companies' characteristics that include market capitalization (size), share prices, dividend yield and earnings yield (value).

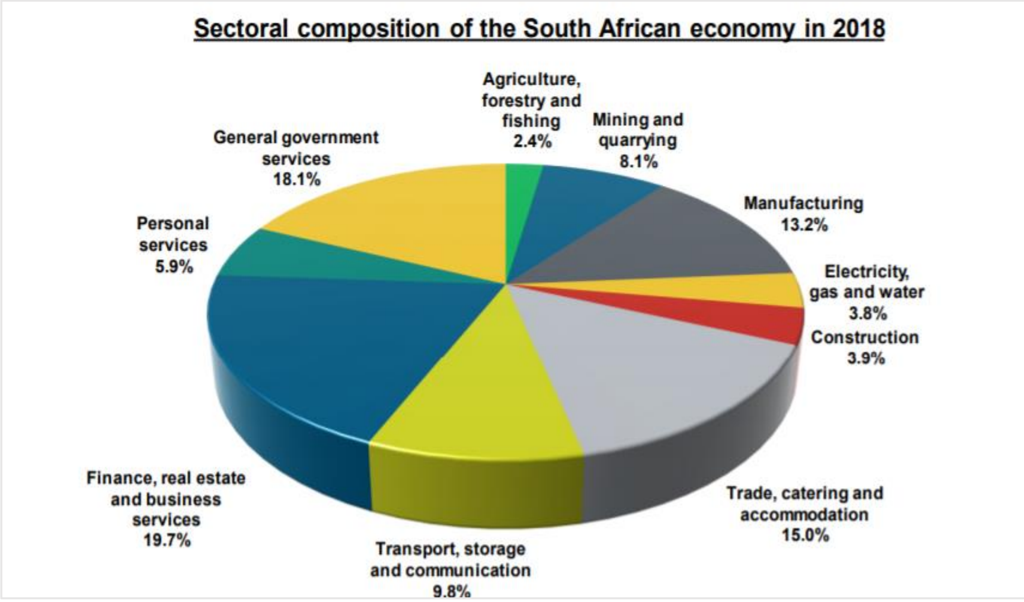
Investment style risks and segmentation differ from country to country due to the different market conditions and regulations set by governments. The policies and laws by the government in different countries delaminate how much can be invested in different assets, especially for Pension Funds which can attribute to market segmentation and style investing effects. In South Africa for example the Regulation 28 and Pension Fund, limits the investments of retirement funds to protect funds against irresponsible investments. Provisions are in place through the Pension Fund Act to limit the asset allocation. For example, the fact that no more than 75% may be invested in equities, no more than 15% may be invested in a large capitalization listed equity and no more than 15% may be invested offshore. Furthermore, even individual investors are regulated by the South African Reserve Bank and provisions such as a good-standing taxpayer may invest up to R10 million in his or her name offshore per calendar year provided a Tax Clearance is obtained, are in place. Such provisions by the law influence where the asset manager will allocate their client's money. Moreover, Asset Managers and Advisors are guided by principles of government bodies like the Financial Services Board and investment management bodies like the Chartered Financial Analyst Institute.

Investors' access to the South African market has been increased by globalization. An essential benefit to investors is diversification of risk across equities and countries for better capital allocations, However, the country is not immune to the challenges that globalization has brought along. Technology and increased international trade have seemingly integrated business cycles and financial markets. This integration has opened the South African market to adverse risks on a global level. An example is the 2008 global financial crisis which affected the economy. Central banks around the globe reacted to inflation by raising interest rates, the South Africa Repo rate rose from 9.50% in June 2007 to 12.00% in June 2008. This further eroded disposable income, making it more difficult to repay loans and the defaults began. Moreover, with rising prices, inflation started to increase, thus, reducing the household disposable income. To date, South Africa is still experiencing the after-effects; this can be noted by the recession.

All this trading by the investors is done on the stock exchange where different assets are traded which gives them access to real-time information on the performances of the different assets. Since the advent of democracy in South Africa, the capital market has grown tremendously and there have been developments in the market. A reflection needs to be granted on whether the developments over the years on the financial markets have been consistently affecting the performance of the securities in the segments. The Johannesburg Stock Exchange (JSE) is the 19th largest stock exchange in the world by market capitalization of R13 590 billion and the largest exchange in Africa. Through the JSE the majority of those who invest in the South Africa stock market are invested through retirement funds, exchange-traded funds or unit trusts. Previously, the JSE mainly consisted of mining, selling produce overseas and sending the money to import stuff. At present, the JSE Is flooded with many individual and corporate investors and asset managers selling financial and other services making the stock market very active. Rumney, 2019). The Business Tech reported in 2014 that the South African market was the second best performing stock market on the African continent after Nambia. According to the South African Market Insights (2019), South Africa is the only BRICS country that is not in the Top 10 biggest economies in the world. The South African economy is 5.3 times smaller than of Russia which is the fourth-smallest country in the BRICS countries. In Africa, South Africa is the second-largest economy after Nigeria. The Nigerian economy is 60% larger than that of this country (South African Market Insights 2019). However, when ranking according to the market capitalization of the 27 national security exchanges in Africa, the JSE is the largest (Coetzer, 2018). It is pivotal for asset managers and investors to obtain excess returns when they invest, however, this could be a challenge as South Africa's economic growth has been stagnating at levels below 1%, while India grows easily above 7% and China is growing at around 6% and has been for decades now (South African Market Insights 2019).

Securities in the market are all instruments listed under three major sectors namely SA Resources, SA Financials, and SA Industrials. These major sectors have been there since South Africa was under apartheid and they tend to influence investors' stock selection leaning towards the more familiar industrial and resources sectors. South Africa historically was a mining country; the majority of the investors chose the gold index industrials. The recognition of these sectors influenced and to an extent still influences decisions that caused the market to be segmented. *Figure 1* below shows the contribution of the different sectors to the total Gross Domestic Product (GDP) of the South African economy in 2018. This clearly shows a change from the dependence on mining and the growth of the other sectors like Finance, Insurance, real estate, and business services; Wholesale & retail trade; Catering and accommodation; Transport, Storage & communication; and Manufacturing performing and having a greater contribution than mining. Thus, investors have to be aware of the sectorial performance as it assists them with the primary indicators that help to gauge the health of SA's economy. Investor confidence is an important part of economic growth.

Figure 1: Sectoral Share of GDP at basic prices (Source: Industrial Development Corporation of South Africa)



Investors use the GDP to make investment decisions. A significant change in GDP, whether up or down, usually has a significant effect on the stock market. A downward or upward change in GDP has significant effects on the stock market when the economy is not performing well. For instance, a bad economy usually means lower earnings for companies, which translates into lower stock prices. Investors worry about negative GDP growth, which is one of the factors economists use to determine whether an economy is in a recession. The SARB monitors and predicts business cycles. Business cycles are part of the global and national economies which play an important role in the performance of securities and investor sentiments. It is essential to analyse the global financial crisis during 2008 which was followed by the Euro-debt crises. Moreover, because of globalization, these business cycles of expansion and contraction affect every country.

The macroeconomic environment makes it extremely crucial for investors to know how indicators such as inflation, GDP, and the rate of growth tell a story about past trends, at the same time, puts into perspective the current and future health of the economy. The economic health of a country is what fuels financial markets. The economic sector gives a picture of SA's economic activities. Thus, when investing in stocks these indicators can assist an individual to predict future movements in sectors and the sector performances can hopefully help to create better investment strategies. SA's GDP growth can be used by some investors as a good predictor of the potential movement in stock prices. It gives a good "explainer", but not necessarily a good "predictor" of stock market movement. Some investors believe that a positive growth rate and economic outlook mean investing value. It's essential to an eye on the GDP reading and estimates this is because government policies and decisions have a direct influence on the financial market. Government and economic decision-makers use the GDP when planning and formulating policies. Hence, investors need to keep an eye. The belief is that if the economy grows by 2%+ there is a good chance the stock market will likewise reflect a positive trend. This applies if market pressures remain relatively normal like the value of the rand against the dollar and global. However, negative GDP growth portrays bad signals for the economy. This serves as an indicator to catch on whether the economy is in a boom, recession, or depression. The graph below shows the South African GDP during the period of the study.

Figure 2: South African Growth Rate (*Source: Compiled by the author*)

The GDP provides investors with insights on economic trend highlights. These trends are essential when an investor is planning where to invest their money especially when it comes to long term investment decisions. Moreover, the GDP assists investors to manage their portfolios by providing them with guidance about South Africa's economic state. An investor or asset manager investing for a long-term would want to recognize or pick up signs of a growing economy and invest accordingly. The graph shows that from 2008 when the GDP growth rate started dropping it was a sign to sell or invest extremely cautiously. Thus, decisions taken between 2008 and 2010 or in a period of the drop in the growth rate had to be researched extensively, not, just based on intuition. Investors may want to manage their sector weightings in their portfolios accordingly because various components of GDP give insights into the performance of major economic sectors. The country has experienced some downturns after the global crisis

The 2008 global financial crisis sent the rest of the world market into financial turbulence that captured much attention. The severity of the crisis-hit countries so hard that they witnessed shattered market sentiments and a drop in share prices. For example, the JSE ALSI in February 2008 was R 30 674 and, by February 2009 it had dropped to 18 465 (JSE, 2019). During this period, the growth figures also dropped as depicted by *Figure 2* which led to a fall in investor confidence. Individual differences and environmental influences that surround investors and equity managers shape their investment decision-making process. Individual influences include the investor's resources such as time, money and information processing capabilities; personality, values, and lifestyle; knowledge, motivation, and attitudes. Environmental factors are made up of culture, education levels, social class, and situation. Investors must be aware of the impact of cultural beliefs before investing in international markets. In the view of Bernstein (1995) majority of money managers and investors can speak the language of market segmentation and style investing phenomenon, but, when it comes to the actual predicting when one segment outperforms the market that requires an understanding of more factors, changing relationships and historical performance that affects that segment.

Equity market segmentation can be viewed as the divergence between stock prices, dividend yields and other market conditions in a country compared to the rest of the world. In developing or emerging economic segmentation is more observable due to legal barriers, high currency uncertainty, high trading costs, political and legal risks, and other macroeconomic factors that are magnified. Segmentation can be seen as damaging the potential growth of investments and the health of an economy. A very important question to ask in any economy is whether the equity market is segmented or integrated for investors, researchers, analysts or asset managers. This concept of segmentation has implications for investors in different countries, thus, causing differences in estimations of the cost of capital and most particularly on the value of the investment.

Economic and regulatory barriers in the stock markets have been eliminated by demutualization. Moreover, the new opportunities provided by information and technology growth have supported the development of stock exchanges in doing their business and thus making international stock exchanges feasible. This integration has created opportunities for diversification for investors. Transactions that include mergers and acquisitions and other forms of cooperation between companies and stock exchanges represent a new strategy to increase the value of stock exchange markets (Dorodnykh, 2013). Therefore, market segmentation or integration are indicators that explain how different markets are separated or related to each other.

Accordingly, the JSE has over 400 companies to date listed on the mainboard and this is affected by different activities in the domestic market and industry-specific undertakings. The challenge is that performance is driven by the resources and macroeconomic factors such as interest rates and industrial production which affect almost all sectors of the economy. Thus, investors are biased towards more developed and well-performing sectors in portfolio selection signals to subdivisions in the equity market. This signals the segmentation of the JSE, thus, questioning the ability of the Capital Asset Pricing Models (Sharpe, 1964; Lintner, 1965; Mossin, 1966) in predicting returns. The JSE being segmented and the predictive abilities of the CAPM, motivate this study. CAPM does not fully withstand the empirical test to fully explain the risk-return relationship. The CAPM does not fully capture all risk factors necessary when computing expected return, thus, market risk alone is insufficient to explain expected return because it does not include firm-specific factors that influence performance such as firm's size and earnings yield. Roll & Ross (1980) criticize the CAPM whether a sole factor affects expected return in the market and if risk and return have a linear relationship. Furthermore, Vardharaj and Fabozzi (2007) reveal that a strong relationship exists between investment styles and sector allocation decisions. Over time sectors mimic behaviour inherent in certain styles in comparison to other sectors. However, these behaviours can be reversed when major events happen like the 2000 technology bubble and the 2008 financial crisis. Thus, sector allocation strategies can be equivalent to style allocation strategies as to the behaviour within sectors adopt characteristics of a style. Investors are driven by the underlying macroeconomic factors during an economic cycle.

On the other hand, securities do not behave identically; at the same time, investors and asset managers do not assimilate information in the same way. Behavioural Finance suggests that investors do not see information the same, due to psychological biases. Investors depict different readings from similar information such that what others see as bad stock can be good to others depending on the styles they use, experience, and beliefs. This emphasizes that investors are not always rational, and decisions are made intuitively or using logic and reasoning. Thus, daily decisions are mostly made effortlessly, but some decisions need careful thinking. It has been shown that not all decisions made from logic and reasoning is correct always. Experience and knowledge are required for good decisions, and at times the mood also plays a part. Thus, the cognitive, emotional state and social environment influence investors' personality and the way they think. Decisions made after a significant event, losing on investment and regretting, from sales professional's influences and projections are usually emotional and lead to bad investing. Thus, the behaviour of investors and risk appetite influences asset allocation and this has an overall influence on the returns.

Many other factors have affected performance of stocks over time including company sentiments, market sentiment economic factors, industry factors as shown in *Figure 2* should be investigated. The problem is that many factors affect the performance of securities at the same time, largely because South Africa has changed a lot over the past 20 years. The challenges facing the local economy include the higher taxes, political uncertainty, lack of consumer and business confidence, the poor performance of the rand and the constraints imposed by generally more expensive and less reliable energy (Sessions, 2018). The JSE performed horribly in 2018 for the first time in 50 years and heavy losses were felt by investors. This poor performance shows that the SA equity market is not sustainable. Typically, in such a state a group of investors tends to buy high and sell low. They buy when the market is euphoric; not realizing that investing then presents the highest risk. They sell when markets are despondent; not realising that this point represents the highest potential for capital returns (Overberg Asset Management, 2018). When the JSE has a sale, people run scared. Benjamin Graham wisely said, "*You should buy at cheap prices when markets are weak, not at high prices when markets are expensive*". At the end of the year, scared investors were selling their shares to willing buyers who have been waiting patiently for this opportunity. The challenges to the economy and the JSE all impact investor behaviour which influences their decision. Many methods have been derived for investors to obtain excess returns, however, there is no one set method for investors to enjoy these returns in bear and bull market conditions.

1.2. Research Problem/Rationale of Study

Emerging markets like South Africa continue to display higher levels of segmentation. Bekaert, Harvey, Lundblad, and Siegel (2011) find that developed market segmentation declined from 4.8% during 1980–1984 to 2.0% during 2001–2005 and over the same period, segmentation in emerging markets also declined, from 6.4% to 4.3%. In different national markets, equities are divided according to underlying assets for example software and computer services are the most integrated industries, on the other hand, banks, insurance, and general retailers are the most segmented industries. Emerging markets are associated with a lack of savings for development and the presence of segmentation of the equity markets drive away inexpensive capital from overseas that might help the economy to grow. Segmentation could also rob local citizens of the capacity to spread their risk and diversify their wealth if laws and other facets of the capital market impede or prohibit their investing some of their savings overseas. Thus, market segmentation may be viewed as harmful to the probable growth and well-being of an economy. Segmentation further affects security selection when the economy is facing a crisis or in a recession.

Since, investors want to be compensated for risk, especially during a crisis; they avoid underperforming sectors and securities. The problem is not knowing the degree of influence that factors like segmentation and style anomalies have on security returns in South Africa given the existing literature and the inadequacy of the capital asset pricing model. The literature on analysing anomalies (value, size, and momentum, profitability, and investment together) is still thin and lacks representation of market crashes over the past 20 years. Historically, in South Africa was there was dominated by the mining sector in comparison to other international markets. Presently the JSE comprises of all listed instruments divided into sectors, under the broad categories of Resources, Financials, and Industrials and this section the market.

Conversely, there are two main theories regarding risk essential when estimating averages that are on opposite ends. One is the agreement with the market risk being the sole risk factor and on the other hand, a theory known as behavioural finance believes that other risk factors, along with market risk, account for expected returns. The CAPM is one of the foundational contributions to finance and is used by most investment managers. It highlights that market risk (beta) is the only important risk after removing firm-specific risk. The base idea is that not all risks should affect asset prices (Perold, 2004). The assumptions of CAPM represent an idealized and highly simplified world that must be obtained in a basic form. CAPM does not fully capture all risk factors necessary when computing expected return, thus, market risk alone is insufficient to explain expected return because it does include firm-specific factors that influence performance such as firm's size and earnings yield. Roll & Ross (1980) criticize the CAPM whether a sole factor affects expected return in the market and if risk and return have a linear relationship. Many other factors have affected performance over time which should be investigated.

There is no conclusive conclusion on the causes of market anomalies and their effect on expected returns in South Africa. Fama and French (1992; 1993; 1996; 2015) question the real-world application and effectiveness of the CAPM through Fama and French three-factor model; Carhart four-factor model and Fama and French five-factor model. Over the years additional factors have been identified that provide explanatory power other than market risk) for average stock returns. These factors identified are called anomalies, thus, Banz (1981) identifies size anomaly; Basu (1977) value; Jegadeesh & Titman

(Jegadeesh & Titman, 1993) momentum; profitability and investment. Numerous empirical studies have found that the cross-sectional variations in average security returns.

Inspired by methodologies of well-cited studies conducted in the US financial environment, studies in the South African stock market (Auret & Cline, 2011; Van Rensburg & Robertson, 2003; Strugnell, et al., 2011, etc.) have yielded different results and there has been no consensus on which model captures the effect of market anomalies and what impact these market anomalies have on the expected returns. It can be argued that due to changes in the economic climate in South Africa market anomalies that have been analysed and documented in academic literature either reverse, disappear, weaken or strengthen. Furthermore, market anomalies adapt to changes in the stock markets, time periods, sectors and economic climate which may cause previous findings to change. It is difficult to defend a position on which market anomalies affect the performance of asset returns on the JSE.

Consequently, another problem arises where the market is segmented because of regulations, market mechanisms, capital costs and behaviours of investors (Gultekin, et al., 1989). Apart, from the segmentation, investors lean towards a few tested investment styles, which hinders growth, while, dividing the market further. For this reason, an evaluation of sectors and the style anomalies relationship with security performances over time is essential. As a result, these regular patterns in returns have been established; hence they lose their predictive power. In light of the changing composition, growth, improvements and the reclassification of the JSE sector indices over the past 20 years it is critical to investigate with the improvements which asset pricing model better explains returns.

Thus, it is difficult to jump to the conclusion that the performance of equities was decreased by the financial crush or that it created opportunities. Implementation of a model requires one to have confidence which revolves around positive testing of the model. Hence, a review of past events including the 2008 financial crises is essential. Furthermore, investors seek answers as to whether they should be concerned about the effects these market anomalies have on expected returns. Overall, there is extensive research on market anomalies worldwide, but there is no clear-cut approach as to which method is the most appropriate for testing these market anomalies and their effect on expected stock returns, especially when different sectors of the stock market are considered. Thus, a further study on the effect of market anomalies on the expected return across all the JSE sectors and, in which asset-pricing models better capture these effects; will shed more light on this topic.

More specifically to this study the Fama and French five-factor model has yet to be proven as an improvement compared to previous models. Most investors still use famous FF3FM. The model seems to work well in economies such as the US but is not the best benchmark in a market like Japan. It takes many years for asset managers and investors to start integrating a model as they may have many doubts. In the South African, context a lot remains as this model needs to be tested over the different economic situations over a longer time frame and compared against different market conditions. Due to individual or investor behaviours (attitudes or irrationality) industry personnel always have doubts that will influence methods to be used. Looking at the practical work done and shown by Fama and French it seems it would be in the best interests for investors to use the other factor models until this FF5FM proves itself in the empirical evidence.

Howbeit, the topic of market anomalies tends to be controversial because the presence of market anomalies tends to vary from sample to sample, implying that it is difficult to generalize the effect of market anomalies on stock returns. Additionally, it has been shown that aftermarket anomalies are analysed and documented in academic literature, they often disappear, reverse or weaken. It is, therefore, important to conduct a further study on this topic. This will give investors a broader view of different methods, which can be used to estimate expected returns, as no one model has been said to be accurate. Conducting a sector analysis will be indicative as to which market anomalies impact expected return of individual sectors and this would give South African investors a clear picture of which sectors are affected more by the specific market anomalies. Overall, this study will add to the existing body of knowledge on the effect of market anomalies and stock returns in different sectors.

1.3. Research Hypothesis

The primary hypothesis of this research is that "the investment style strategies (value, size, and momentum) and sector allocation strategies used by investors have an influence on the JSE security returns over time." The hypothesis is stated as follows:

Hypothesis 1: Capital Asset Pricing Model do not exhibit relevant predictive abilities for expected returns on South African equities in both a bearish and bull market

Hypothesis 2: Performance of securities on the JSE is not influenced by investment style risks (value, size, momentum, profitability, and investment) *(Null hypothesis)*

1.4. Research Questions

This study attempts to answer the overall question, "To what extent do investment style risks influence the security selection and performance of sector returns on the JSE over the period 2000 to 2016?" This main question is subdivided into the questions below:

1. Can further evidence be generated that the Capital Asset Pricing Model is able to fully explain the performance of securities on the different sectors on the JSE?

2. Which asset pricing model best explains expected returns on the JSE securities? If style anomalies are present, to what extent do these anomalies, value effect, size effect momentum effect, profitability effect and investment influence sector performances over the examination period?

1.5. Research Objectives

The main goal of this study is to examine the effects of the systematic risk-based factors (i.e. selected market anomalies) on the performance of securities on the different sectors of the JSE. In accordance with the primary objectives of the study, the following secondary objectives were formulated:

1. To determine the predictive ability of the CAPM in explaining the performance of securities on the resources, industrial and financial sectors of the JSE (Cross-Sector Analysis using the CAPM).

Of special interest to this study is the determination of the predictive abilities that the CAPM has; a model conceptualized over 50 years ago, in the South African Market, in explaining security expected returns. Testing the CAPM will assist in the identification of the influence anomalies have on expected returns and power of market risk.

2. To compare the performance of different asset pricing models and their ability to account for anomalies on the resources, industrial and financial sectors of the JSE (Cross-Sector Analysis using Multi-Factor Models). Infer if the Fama and French three-factor model and the Carhart (1997) four-factor model provide reliable evidence of style anomalies on returns. Also, the applicability of the Fama and French (2014) and Five-Factor model (2015) in estimating the expected returns on the JSE would be tested.

1.6. Conceptual Definitions

Thus, this section gives an account of the description of these theoretical models that lead to the FF5FM.

1.6.1. Factor

A factor used in the asset pricing models can be described as a quantifiable signal that shows a certain level of correlation with the returns of an asset. Thus, beta, size factor, value factor, momentum factor, profitability factor, and investment factor are financial factors that have been tested and some level of correlation with expected returns were proven. Typically, good factors show consistent relationships with the asset and have a fundamental intuition for doing so. For example, the value factor is derived from the market value and price-to-book ratio of a firm. The value factor has been tested on the market and it exhibited some levels of correlation with companies' securities returns. Therefore, the factors are firmly related to firms' financial well-being. The famous factors start from the CAPM; however, the Random Walk gave rise to notable theories in the financial environment.

1.6.2. Random Walk

Random Walk (Fama, 1965) implies that security price changes on the stock market are independent from each other, meaning that past movement cannot be used to predict future patterns or movements of securities. Thus, stock price movements do not follow a pattern. News should flow unhindered because news is unpredictable and random. When news or new information about a security is received it rapidly spreads and tends to be quickly reflected in the share price. Price changes are random and unpredictable. According to Samouilhan (2006), the JSE is highly liquid, but the levels of liquidity and volatility are constantly changing as new information is priced in. The price determination on the JSE is highly influenced by information regarding behaviours of key economic variables such as exchange rate, gold price, and interest rates. On the JSE price change are unpredictable just like any other stock market. The changes that occur on prices greatly influence the returns. The rand's depreciation largely affected listed securities which influenced the return. These positive fluctuations can lead to opportunities to raise more capital, vice-a-versa, the negative occurs, thus a bearish condition, which erodes wealth, spending and purchasing power. It is difficult to predict consistently how the market or securities will perform partly because of the different global and national macroeconomic factors in the market and psychological effects and speculation from investors.

1.6.3. Efficient Market Hypothesis

Fama (1970) revised the empirical work of the Random walk introduces the different prices of market efficiency further expanded under the Efficient Market based on information reflected. Efficient Market Hypothesis is a fundamental theory underpinning all areas of finance and it suggests that all information is available in the market. Thus, investors cannot outperform the market or consistently earn abnormal returns. The alternative forms of the EMH which differ in information availability are Weak-form hypothesis, Semi strong-form hypothesis, and Strong form hypothesis. Deviations from the random walk suggest information efficiency on the stock market and such deviations include anomalies. (Samkange, 2010; Phiri, 2015) have argued in the form of efficiency on the JSE and have found weak-form informational efficiency. However, this conclusion is not common for all researchers.

1.6.4. Capital Asset Pricing Model

Capital Asset Pricing Model (Sharpe, 1964Lintner, 1965Mossin, 1966) is a powerful tool used to measure risk and depicts the relationship that exists between expected returns and systematic risk. The CAPM is derived using the principles of diversification, thus, betas coefficient (market risk) is the only relevant risk when computing expected returns. The assumption is that investors cannot affect security prices by their individual trades, but security prices are driven by the market (Bodie, et al., 2010). Many researchers have critiqued the CAPM and have concluded that it's mi-specified which led to multifactor models. Multifactor models can provide better descriptions of security returns because they allow for several systematic factors. These models give clarity in a much better-off way to think of risk exposures and compensation for exposure to risks than CAPM. Fama and French (1993) identified the size factor and value factor (book-to-market) to proxies that better explain the systematic factors. In addition, Carhart (1997) added a momentum factor to the systematic exposures because momentum capacitates the explanations for observed tendencies of rising security prices to continue rising and falling prices to continue falling. These three systematic factors added to the CAPM are known as anomalies.

1.6.5. Investment Style Risks

Investment Style Risks (i.e. style anomalies can be defined as patterns that seem to contradict the EMH, thus, reflecting some market inefficiencies. Firstly, the value effect (Basu, 1977) tendency for value stocks to outperform growth stocks. This compared the book value of a firm with its stock price. Secondly, size effect (Banz, 1981) refers to an anomaly where small firms (that is, smaller capitalization) outperform larger firms. Typically, small firms can grow faster than large companies which are reflected in the security prices. A company's economic growth is the major driving force behind its stock's performance. Thirdly, momentum effect indicates the rate of change in the price of security where investor irrationality can cause security under or overpriced. Stocks performing poorly, and well-performing tend to continue that abnormal performance in the following periods. Momentum effect can be divided into long-term momentum effect by De Bondt and Thaler (1985, 1987) and short-term momentum effect by Jegadeesh and Titman, (1993). Long-term momentum effect suggests that loser portfolios outperform winner portfolios over a long period of 3 years. Short-term momentum effect found that stock performing good or badly recently (short term to medium term period of 3-12months) will continue over time. The performance of individual stocks in highly unpredictable according to the random walk, however, portfolios of best performing stock in the recent past offers opportunities to outperform other stock with reliability. Momentum effect suggests that the market overreacts to news, thus, bring in the human element.

1.6.6. Behavioural Finance

Behavioural Finance examines the impact of psychological biases on the decision-making process by investors. The focus is on the systematic irrationalities that characterize the investor and asset managers' decision making, which may be consistent with the efficient market anomalies. Investors are constantly looking for ways to exploit the market and be compensated for the risk taken. This rejects the assumption by EMH and CAPM that investors are rational. Behavioural irrationalities can be split into two categories, namely, information and behavioural biases. Investors' errors in information processing can attribute to misestimating of the true probabilities of possible events associated with the anticipated return. Sources of information processing include overconfidence, sample size neglect, and representativeness bias, conservatism, and forecasting errors. On the other hand, behavioural biases largely affect how investors frame questions of risk versus return, therefore, making risk-return trade-offs (Bodie, et al., 2010). Emotions play an important role in all kinds of behavioural biases. For example, mental accounting, regret avoidance, heuristic simplification, and choice framing.

1.7. Outline of the Thesis

This research is structured into six chapters. Chapter one introduced the research background, research problem, research hypothesis, research objectives and justification for this research. Chapter two provides a theoretical framework that outlines in detail the basic concepts of asset pricing theory, with an exclusive focus on multifactor models in the "beta-return" format. Here the Efficient Market Hypothesis is presented and critiqued together with the market segmentation, information efficiency, asset pricing models including the Fama and French Five-factor model. Chapter three cultivates from the theoretical framework and provides scholarly literature from both the international and South African markets as both markets are investigated in style anomalies and market segmentation.

Furthermore, chapter 3 attempts to determine the similarities and differences in previous studies so that gaps to be studied can be identified. Chapter four will outline the data sample and discuss the methodology that will be applied in the research. Thus, the sample period, the sample of shares to be used, adjustments to the data, firm-specific factor variables and potential area of biases will be discussed. The monthly share and accounting data required for this study which will be inputted in the CAPM, Fama, and French 3 Factor model; Carhart 4 factor model and Fama and French 5 factor model will be discussed. The Fama MacBeth regressions employed in descriptive statistics analysis will also be discussed. Chapter five presents the empirical findings, analyses the data collected and provides a discussion on the findings of the research. The payoffs of the various portfolios analysed and regressed over the 17-year period will be compared. Chapter six concludes the research and points out the recommendations and implications of the research in the South African equity market. Thus, a summary of the study will be provided, together with conclusions on the effects of style anomalies and suggestions for further research pertaining to this topic will be drawn.

1.8. Chapter Summary

Summarily, this chapter has discussed the problem statement, research objective, research question, and significant style-risk variables. These will figure out the relationship of the stock market volatility and the independent variables which are inflation rate, foreign direct investment, exchange rate, financial crisis, and interest rate. Besides that, this chapter also stated the aim of the research which examines the significant relationship between the macroeconomic factors and the contribution of existing articles about the behaviour of the equity market. The chapter that follows serves as the foundation on which this study will describe the academic framework on the basic relation that exists between risk and return.

CHAPTER TWO: THEORETICAL FRAMEWORK

2.1. General Overview

The Efficient market hypothesis has caused much debate in the financial stock markets. This area of research has attracted many scholars including (Fama 1965; Fama 1970; Roll, 1977, Malkiel, 1973 & 1992; Roll & Ross 1980; van Rensburg, 2000) for various reasons. Extensive research has gone into developing and testing models that attempt to explain the value securities and measure the performance of shares. The debate was sparked by the discovering of the random walk which some rejected that stock does not move in a random fashion, but, is dependent on the information available in the market. Hence, the various asset pricing models thereafter debate the assumption of market efficiency, that asset prices reflect all available and relevant information fully and are therefore correctly valued (Fama, 1970).

Researchers and financial practitioners have all been debating about the validity of the EMH and behavioural finance. One of the views is that the EMH strongly believes that investors make rational decisions in order to capitalise expected utility (Markowitz, 1952). Alternatively, behavioural finance suggests that markets are not rational, and investors make irrational decisions, which may lead them to over- or under-pricing stocks (De Bondt & Thaler, 1994). This is where the segmentation begins in the financial stock market. EMH then goes on to assume that markets are efficient only when all relevant information is reflected in the price of a security, behavioural finance considers that markets are not as efficient as the EMH suggests, and to some extent, security prices are predictable. It has been established in past studies (Banz, 1981; Basu 1977; Bhandari 1988; Fama 1992 &1993, 2014 & 2015; Bowie & Bradfield 1998). that markets are efficient as expected returns were found to be higher than market returns.

The matter of style effects stems from the efficient market hypothesis and asset-pricing models, and the empirical finding that 'anomalies' exist when these models are tested. Anomalous results may perhaps suggest an inefficient market, or an incorrectly specified model, or both, due to the fact that investigations of market efficiency cannot be separated from the tests of asset-pricing models (Fama; 1991). These anomalies are termed 'style' factors and it has been established empirically that style characteristics like size; value and momentum can be used to predict future returns to some extent either in their own capacity or by including them as factors in models like the CAPM and APT. Information efficiency and asset-pricing theories form the basis upon which tests can be done to investigate style anomalies empirically and assess whether these style anomalies are present in an international setting.

Therefore, before we can examine the style-anomalies, it is necessary to consider the academic theory that has had the most influence on modern investment practice, thus, information efficiency and asset pricing theory. This is directly linked to security valuations and return predictability, which have been the main areas of focus for both investment practitioners and academics for many years. This chapter, therefore, discusses the information efficiency and behavioural finance cases with emphasis placed on the asset pricing models as they affect market anomaly, which is tested in this study. Firstly, it discusses the asset allocation decisions under conditions of uncertainty which leads into the three forms of market efficiency and its implications. Thereafter, the CAPM and its critiques are discussed. This chapter continues to discuss asset pricing models. Lastly, it summarises and concludes with the theoretical framework that guides this study.

2.2. Asset Allocation Decisions Under Conditions of Uncertainty

i. Modern Portfolio Theory

In the 1950s, Henry Markowitz developed the Modern Portfolio Theory (Markowitz, 1952) which is a simplified concept of making security choices based on expected return and risk of a collection of assets. Risk is defined as the chance of loss, however, in investing it is captured by the return dispersion usually measured by the standard deviation. Thus, the expected return is the amount of profit that is expected from a security over the holding period (i.e. investment horizon). The focus is on investors' attention on the investment portfolio which makes and provides an attractive trade-off between risk and return. The most basic assumption of the portfolio theory is that investors seek out investments with the potential to provide maximum benefits. Investors are constantly looking for the highest expected return for a given amount of risk or the lowest possible risk. Investor attitude towards risk is based on the concept of risk-aversion and this is explained by the expected utility theory. Asset or security investors get utility (i.e. positive benefits) out of the increase in the expected return and inversely suffer from disutility (cognitive loss) from an increase in the amount of risk. Thus, investors seek out investment portfolios with the characteristic of providing maximum expected return for the minimum anticipated risk invalid source specified.

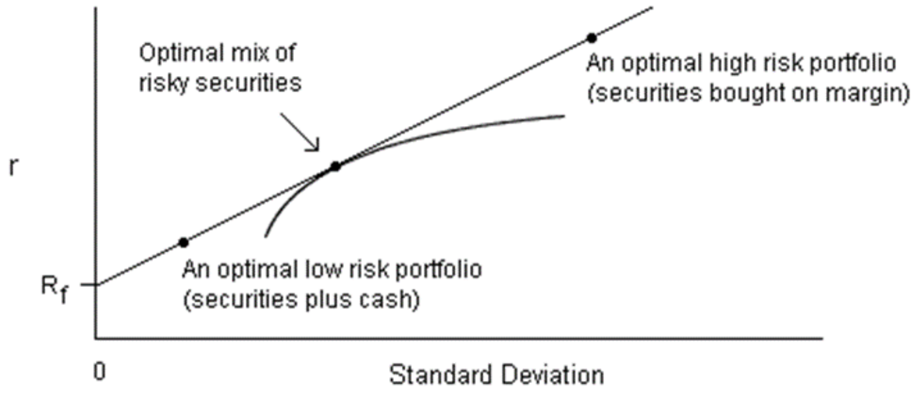
Investors make decisions between alternative investments based on the expected utility. Decision making for investors is based on the utility function and not subject to psychological biases since decisions purely depend on probabilities of the various asset positions of an investment. Risk is expected to be diversified away.

ii. Separation Theorem

Tobin (1958) in his paper stated that before making any decisions investors should first determine their risk appetite. This appetite should be satisfied from the one dominant equity portfolio determined from a Markowitz optimization (the single portfolio on the efficient frontier with the highest return per unit of risk). Investors as viewed as a homogeneous group which has similar expectations over the same one-period horizon and the same risk-free rate. In addition, they have similar information which is freely and instantly available to all investors. This situation allows the focus to alter from how an individual should invest in what would happen to security prices if everyone invested in a similar manner. This first feature of the assumptions examined is regularly referred to as the separation theorem. This theorem states the optimal combination of risky assets for an investor can be determined without any knowledge of the investor's preferences towards risk and return. Evidence of which is minor since each individual faces the same linear efficient set, where the financial practitioners will borrow or lend according to their indifference curves, but the risky portion of each investor's portfolio (which we will denote by T, for tangency portfolio) will be the same. The linearity of the efficient set is because of the risk-free lending and borrowing introduced. Portfolio choice can be separated into two stages, firstly, find the efficient portfolio of risky assets and secondly, find the optimum fraction to invest in the efficient portfolio of risky assets and the risk-free asset. Tobin (1958) stated that if you hold risky securities and are able to borrow - buying stocks on margin - or lend - buying risk-free assets - and you do so at the same rate, then the efficient frontier is a single portfolio of risky securities plus borrowing and lending.

Tobin's Separation Theorem says you can separate the problem by first finding that optimal combination of risky securities and then deciding whether to lend or borrow, depending on your attitude toward risk. It then showed that if there's only one portfolio plus borrowing and lending, it's got to be the market. When an investor is trying to construct an optimal portfolio for their risk tolerance will lie somewhere on the straight line joining the risk-free rate to some optimal mix on the efficient frontier. Sharpe (1964) specifically assumes that high-risk investors can and will buy on margin, with money borrowed at the low rate risk-free. That explains the one straight line depicted in the figure below and one unique optimal mix on the efficient frontier. Therefore, this, justifies the theorem so the problem of constructing an optimal portfolio is "separated" into somehow discovering the optimal mix and then combining it with cash (rf) to give you your desired risk tolerance. Thus, what's certainly stimulating is when everyone is facing the same efficient frontier and the market is efficient it behaves as if everybody is on your straight-line portfolio this way.

Figure 3: Separation Theorem (Source: Rzepczynski, 2018)



2.3. The Efficient Market Hypothesis

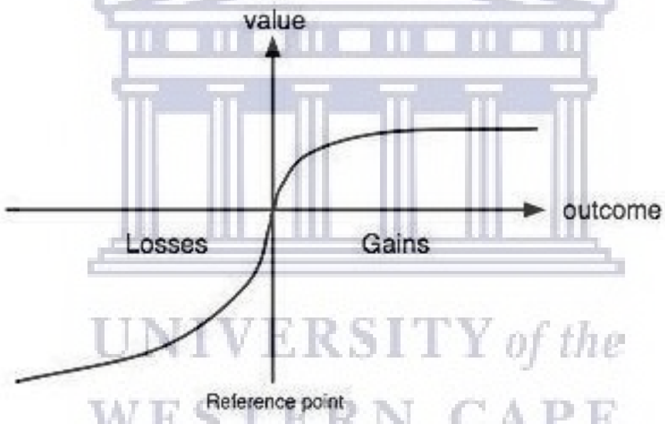
Efficient Market Hypothesis (EMH) by (Fama, 1970) postulates that it is impossible to beat the market because market efficiency causes all relevant information public or private to be reflected in the existing share price. Hodnett & Hsieh (2012) define an efficient market as a market where investors cannot outperform their rivals by generating abnormal risk-adjusted returns in a consistent manner. Thus, it is pointless for investors to search for undervalued securities or try to predict the trends because investors make use of the information such as historical price patterns and company financial statements accessible to them as tools in trading available assets in the capital market. The foundation on which the EMH has been developed stems from the theories relating to investor asset allocation decisions and asset pricing theories in an efficient market (Fama, 1970). EMH suggests that investors are rational, risk-averse and have homogenous expectations. (Kendall & Hill, 1953) Kendall (1953) states that asset prices follow a random walk, thus the future performance of shares cannot be accurately predicted using tools such as technical analysis. Random walk behaviour of asset prices is ascribed to by the immediate assimilation of new information available in the market in asset prices through competition of market participants, thus, making completion a fair game in the market. Accurate information must be available to all participants as soon as the information is available there must be no trade barriers to trade. Therefore, no form of information can be used to generate risk-adjusted returns.

Fama (1970) introduces different forms of market efficiency under EMH which separates information into three forms namely the weak, semi-strong and strong form based on the manner in which different types of information is reflected in security prices. Each form of efficiency has the ability to dismiss the likelihood of consistent outperformance by a certain group of investors who use a certain type of information as a tool in their trading activities such including fundamental analysts and technical analysts. The weak-form maintains that all historical information about a firm such as price charts and volumes traded has already been factored into the price of securities. This implies technical analysts cannot earn positive abnormal returns in a consistent manner in their investment decisions. The semi-strong form based on the notion that all publicly available information such as company performances in financial statements has been accounted for in the securities price making it difficult for fundamental analysts. Furthermore, the strong-form of efficiency holds that all private information is included in the price of the security, implying that investors will not be able to outperform the market based on insider information. Strong-form of efficiency suggests that insider information does not exist (Hodnett & Hsieh, 2012). Therefore, the main argument of EMH is that capital markets are efficient, and investors are unable to consistently generate abnormal risk-adjusted returns. Nonetheless, analysts and researcher continue to ask, are markets really efficient?

2.4. Behavioural Finance

A new theory was developed that contradicted the assumptions of the efficient market hypothesis (EMH), which is known as behavioural finance. Behavioural finance explains how human psychological and sociological factors influence the decision-making process of investors in the presence of risk (Ricciardi, 2000). While EMH is based on investor rationality behavioural finance is based on investor irrationality. According to Statman (1995), investors' emotions influence the processing of information and investment decisions depend on how information is presented. Furthermore, the basic school of thought within behavioural finance is the prospect theory introduced by Kahneman and Tversky (1979), they defined the decision-making process in the presences of risk with two scenarios, either decide on the prospects which is defined as the probability of the outcome or decide to gamble on an outcome. The prospect theory is a critique of the utility theory on which risk aversion is based and introduces the concept of loss aversion. The concept of Loss aversion implies that investor's place more emphasis on avoiding losses then they do on gains. Kahneman and Tversky (1979) conclude that investors are willing to take on more risk when faced with making losses. For example, 1, an investor has to decide on either option A; 80% chance of losing R10, 000 or option B; a definite loss of R7, 000. Thus, in line with their finding's investors would deem the higher risk option A as most preferable. For example, an investor has to decide on option A; guaranteed R10, 000 or option B which has a probability of receiving 80% of 15,000 or 20% of nothing. Their findings state that Option A would be preferred although B provides a high probability of a higher return than A. this is referred to as the certainty effect (Hodnett, 2012). According to Hodnett (2012), the presences of irrationality when making investment decisions criticizes homogenous expectations of investors assumed by Tobin (1958) which suggests that all investors would recognize and hold the optimal portfolio defined by Markowitz (1952).

Figure 4: Prospect Theory: (Source: Murad, Prospect Theory: How Users Make Decisions)



Ricciardi (2000) places emphasis on three themes apart from the prospect theory that serves as an introduction to investor's behavioural biases. These include overconfidence which refers to the tendency of investors to overestimate successful predictions leading to misspecification of either associated risk or expected return. Furthermore, Cognitive Dissonance states that investors tend to simplify opposing behaviour of the market so that it may seem to follow logically from theoretical viewpoints or investment styles. Ricciardi (2000) gives an example of financial cognitive dissonance as when investors change their investment philosophies to support their financial decisions. In addition, the regret theory explains the emotional distress of reporting bad investment decision. Thus, investors may refrain from selling assets that have dropped in value in order to avoid the regret of having made a bad investment decision. Statman (1985) refers to regret theory and overconfidence as a consequence of loss aversion. The presences of irrationality in capital markets have led to much criticism of EMH and capital asset pricing theories.

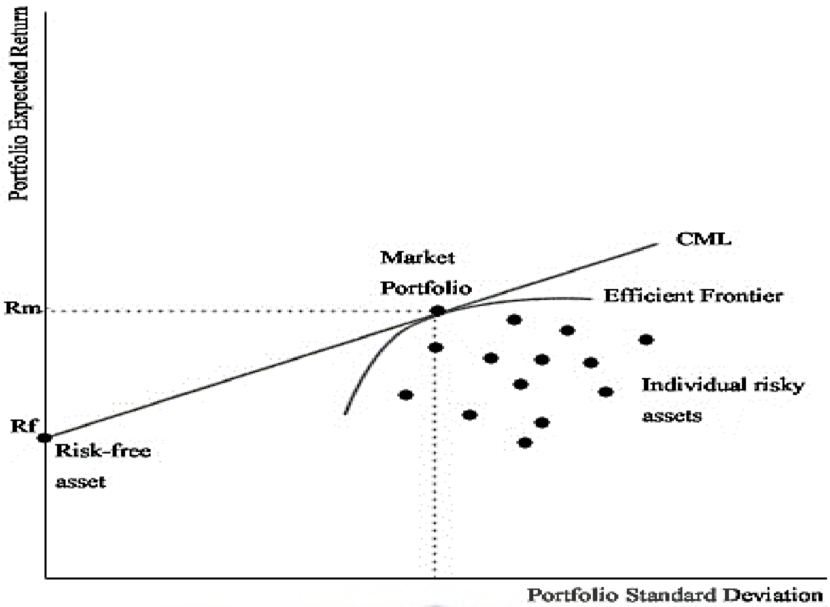
2.5. The Capital Asset Pricing Model

Capital Asset Pricing Model (CAPM) is based on the efficient market hypotheses and it is developed from the Modern portfolio theory (MPT). Sharpe (1964) and Lintner (1965) independently developed the CAPM with the use of the portfolio theory to establish market equilibrium (Krause, 2001). According to Harrington, (1983), CAPM is one of the simplified and there most practical versions of the Markowitz portfolio model. This extension of the MPT is one of the first asset pricing models to link risk and return in an efficient market. The CAPM offers a commanding and intuitively pleasing prediction about risk measurement and expected return. According to Harrington (1983), CAPM has eight assumptions; the first five emphasize the EMH while the last three are required to develop the CAPM from the MPT. The role the assumptions play will be discussed, the assumptions are: 1) investors' objective is to capitalize on the wealth utility of the investment at the end of the holding period, 2) risk and return are what investors' use to choose, 3) investors' have the same estimates of risk and return, 4) investors have indistinguishable investing periods, 5) information is easily available to everyone, 6) Investors can borrow and lend at a risk-free rate, 7) Taxes, transaction costs or other market limitations do not exist, 8) The quantity of all assets is given and fixed, and they are marketable and dividable.

The model can be a useful predictive tool even if its underlying assumptions fail to be met. Due to the simplification of the assumptions and the difficulties in its implementation, CAPM's empirical problems reflected in its theoretical findings. Criticisms that face begin with the taxes and transaction costs which exist in the real world. The CAPM theory of Sharpe (1964) and Lintner (1965) defines risk as to the sensitivity of the security's return to the market's return (beta- unsystematic risk). Today CAPM remains relevant but need to be adjusted for other risk factors identified as anomalies to fully explain return. The security market line (SML) depicted in figure five below is a graphical representation of the CAPM. It provides analysts with a benchmark for the evaluation of investment performance.

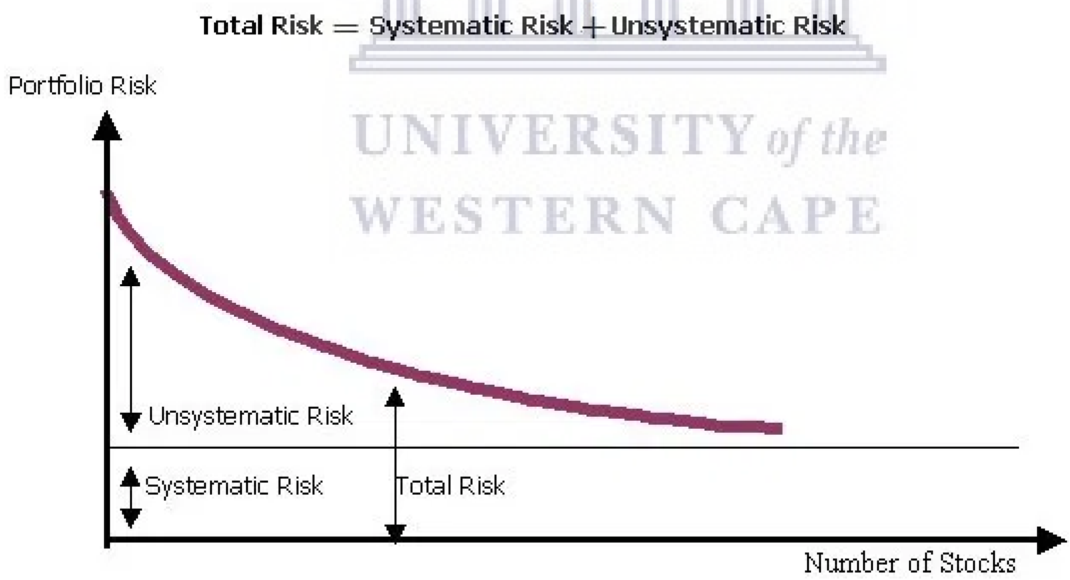
The CAPM demonstrates the market portfolios the efficient frontier as shown in *Figure* 5. For the reason that each investor makes use of the market portfolio (denoted, M) the optimal risky portfolio called the Capital Market Line (CML) (Bodie, Kane, & Marcus, 2012). Therefore, with CAPM determining the fair price of investments, an attempt is made to prove if the fair value of the stock is a good buy or not. Thus, graphically there are two components required to produce the CAPM and these are the CML and the Security Market Line (SML). CML is a tangent line depicted from the risk-free asset through the market portfolio subject to standard deviation as the risk level. CAPM assumes all investors hold the market portfolio as differing only in the amount invested in it as compared to investment in the risk-free asset. CML allows an illustration of risk that investors would earn from accepting additional risk, thus, allowing investors a visual aid of the risk of an asset in an existing portfolio that must be considered. As shown in the *Figure* below the market portfolio is the point where the CML line is tangent to the Markowitz efficient frontier. Points inside the efficient frontier are inefficient portfolios in that they offer a similar level of return with a higher level of risk or a lower level of return with the same amount of risk. When plotted together, the point at which the CML is tangent to the Markowitz efficient frontier is the optimal combination of risky and risk-free assets based on market prices and market capitalizations. Non-efficient portfolios are not represented on the CML. For this the alternative, SML is subject to beta as the risk level due to diversification must be used. Thus, diversification limits the exposure to any one source of risk.

Figure 5: Capital Market Line (Source: CFA Institute)



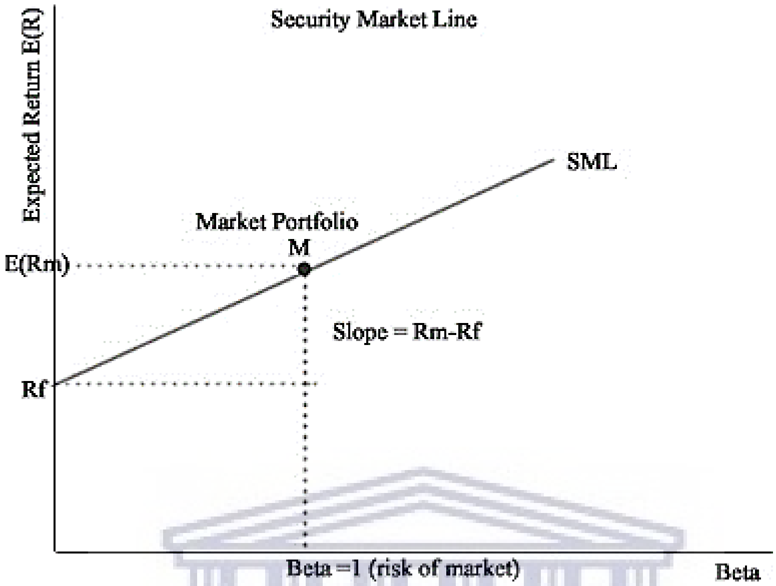
The risk investors are willing to accept for the return is received in the future and is subject to the assumption that investors have to the compensated for the time value of money and the risk premiums. Central to CAPM and SML is the concept of beta. Thus, beta is that systematic or non-diversifiable risk as shown in *Figure 6* below. Thus, after diversification, only, systematic risk is left from total risk because it cannot be eliminated.

Figure 6: Total Risk (Source: Shaikat, Is It Possible to Minimize Systematic Risk?)



Therefore, beta with a higher value than one signifies a risk level greater than the market average, whilst when the value is lower is below market beta. Positive beta indicates that the return of an asset moves in the same direction as the market, whereas a negative beta indicates that the return of an asset moves in the opposite direction of the market. Investors commonly use the SML for evaluating a stock's expected return against its level of risk to determine if its favourable enough to be added to an investment portfolio. If a stock appears below the SML it is considered overvalued in price because for a given amount of risk, they yield a lower return, while securities above the SML are undervalued because they offer a greater return than the market risk. Thus, fairly priced securities will be plotted on the SML. In addition, the SML can be used as a tool for comparing stocks with the same risk level to show which stock offers the greatest return against the level of risk. However, SML as a comparison should not be used in isolation as a sole consideration for expected return over risk-free rate of return when making investment choices.

Figure 7: Security Market Line (Source: CFA Institute)



i. Limitation of the CAPM

The limitations of the CAPM are mainly derived from its inputs and its assumption. Firstly, it is virtually impossible to prove investors behave in accordance with CAPM theory (Roll, 1977). It is hard to show that all investors are rational and risk averses as behavioural finance goes on to show that investors are irrational. Secondly, the commonly accepted rate used as the Rf is the yield on short-term government securities. The issue with using this input is that it yields changes daily, creating volatility (Limitations of Capital Asset Pricing Model, 2017). Furthermore, there is no such thing as risk-free security. The underlying idea of CAPM specifically the risk-free rate that investors can borrow and lend at a rate that possesses no default risk is unrealistic. Individual investors are unable to borrow (or lend) at the same rate as the government, which is often forgotten under the model (Seeking Alpha Marketplace, 2018).

The return on the market can be described as the sum of the capital gains and dividends for the market. A problem arises when, at any given time, the market return can be negative. As a result, a long-term market return is utilized to smooth the return. Another issue is that these returns are backward-looking and may not be representative of future market returns. (Limitations of Capital Asset Pricing Model, 2017). Lastly, it is impossible to verify the CAPM as recent studies have questioned its validity (Kürschner, 2008; Wakyiku, 2010; Nel, 2011).

ii. Critique of the CAPM

No model is flawless, but the CAPM fails to account for various factors occurring in the real world, leading investors to make misguided investing decisions (Seeking Alpha Marketplace, 2018). The basic CAPM model does not account for taxes and transaction costs (Palmiter, 2003). This model assumes that trading is costless, so investments are prices to fall in line with the CML, and investment trading is tax-free, and returns are unaffected by taxes. In the real world, we know trading involves significant transaction costs. Furthermore, many investment transactions are subject to capital gains taxes, thus adding transaction costs. Therefore, taxes decrease expected returns for many investors, thus affecting their pricing of investments and different returns are taxed differently, thus inducing investors to choose portfolios with tax-favoured assets. Additionally, different investors are taxed differently, thus leading to different pricing of the same assets (Palmiter, 2003).

It is also quite unrealistic that all investors have homogeneous expectations and that they all act rationally, based on the expected return and the standard deviation (Kürschner, 2008). The CAPM assumes invests have the same beliefs about expected returns and risks of available investments. Nonetheless, there is massive trading of stocks and bonds by investors with different expectations and investors have different risk preferences (Palmiter, 2003).

One of them is obviously the single period time horizon of the model. This means that investors are only concerned with the wealth their portfolio produces at the end of the current period. Investors, in reality, have the intention of securing their lifetime consumption level by the means of investing (Kürschner, 2008). Making optimal investment decisions by considering returns over a single period model, is just achievable under further assumptions (Armitage, 2005).

The CAPM assumes the existence of zero-risk securities, of various maturities and sufficient quantities to allow for portfolio risk adjustments. The CAPM assumes investors can borrow money at risk-free rates to increase the proportion of risky assets in their portfolio. However, this is not true for smaller, non-institutional investors. This model uses the past to make determinations about the future. By taking the Beta value of a certain security, the model evaluates the past volatility of that certain security to determine future volatility. The CAPM model possesses the underlying assumption that the only risk in pricing a portfolio or evaluating expected return is systematic when in reality there are various risks that 'diversifying' your portfolio may not avoid (Seeking Alpha Marketplace, 2018).

In addition, asset managers and investors seem to be concerned with both market risk and systematic risk. Market risk is what's lacking as many other essential risks are present in the market which must be incorporated when explaining the relationship between risk and return. Furthermore, accurately determining one to properly assess the project is difficult and can affect the reliability of the outcome. Therefore, the SML may not produce a correct estimate of return on investment. Despite all critics, CAPM has continued to get popularity among investors all over the world due to the positive aspects of its workings. This model is considered as a useful tool by the investors for having it in their investment appraisal kit (Capital Budgeting Techniques, 2019).

2.6. Adaptive Market Hypothesis

The Adaptive Market Hypothesis (AMH) was proposed by Professor Andrew Lo (2004) and he attempts to reconcile market efficiency with behavioural finance by applying principles of evolution, thus, competition, reproduction, and natural selection to social interactions in a socio-biological framework. The AMH states that individuals are piloted by bounded rationality under which they search for a solution that is considered "good enough" as the costs of perfect optimization are constrained (Lo, 2004). The AMH can be viewed as a newer version of the Efficient Market Hypothesis (EMH), derived from evolutionary principles. In recent years, although there is evidence to support the fact that stock prices do not follow a random walk and possess some components of predictability, there is a lack of alternative theoretical explanations to the EMH. Thus, using an evolutionary approach, Lo proposed the AMH which could coexist with EMH in an intellectually consistent manner (Hiremath & Kumari, 2014). The five basic tenets of adaptive markets are that individuals act in their own self-interest; individuals make mistakes; from the mistakes, the individuals learn, adapt, and innovate competition drives adaptation and innovation; natural selection shapes market ecology and evolution determine market dynamics (Lo, 2004) friction exists in the market.

The AMH starts with the observation that there's no guaranteed return on equities or bonds. Their performance depends on particular market conditions, and those conditions evolve over time. In other words, there are periods when equities will do well, and there are periods when equities won't do well.

So, if one’s goal is to retire with a particular level of wealth, the individual needs to manage their asset allocation dynamically. When equity markets have a higher expected return, you’ll want to tilt more toward equity markets; when equity markets have a lower expected return, you’ll tilt more toward bonds (Jaye, 2017). The EMH says that prices fully reflect all available information, thus, there is no use trying to pick winners or losers or timing the market. An individual need to just consider his or her own risk preferences, their age, their income, and the kind of retirement they would like to have Thereon, the individual would have to formulate their asset allocation to stocks and bonds to maximize their chances of achieving these goals.

i. Limitations of the AMH

There are several limitations to the new framework of AMH. According to Lo (2012) the literature discusses the five implications for investors, portfolio managers and policymakers. The AMH applies these limitations to form a case for an evolutionary framework which suggests how prices, probabilities, and preferences interact and constitute market equilibrium. The first implication, which is the function of market participants and the business environment, refers to the unstable risk and reward trade-off. From the investment point of view, when markets are disrupted, investors tend to move to safer assets as opposed to the riskier assets. However, investors will have to reduce their investment in risky assets and therefore rely on the return from the safer asset.

The second implication is that market efficiency depends on the proportion of market participants who are making investment decisions. Markets which have existed for long periods of time are more efficient than those which are new. However, these markets can be inefficient as the environment changes or Investors' attitudes change. As a result, the third implication is formed, which refers to the idea that investment styles should change in tandem with changes in the market environment.

The next implication involves an important consequence of competition, innovation and natural selection in financial markets. Lo (2012) explains this by referring to the alpha, which should equal 0. However, when abnormal returns are presented and therefore the alpha is higher than 0, investment opportunities are taken by investors and the alpha will become 0 again. This can be referred to as an arbitrage opportunity.

The final implication explained refers to asset allocation in an Investment. In a stable environment asset allocation in a portfolio would be 60% stock and 40% bond. However, during significantly volatile market times and as the risk premiums increase asset portfolio weights may not be very useful from a decision-making perspective. Investors are more concerned with risk and reward than their portfolio weights. Investors may decide to go with an annualized return volatility of 15% for the entire portfolio as a starting point of an asset allocation strategy, for instance, 3% in bonds, 100% in equities and 20% in commodities. As the volatilities and correlations of the assets change over time, the portfolio weights change to maintain constant risk weights and portfolio volatility as investors experience fewer surprises with respect to their portfolio risk levels.

In the traditional investment theory, investors struggle to make active choices as market timing is almost impossible and ineffective. This provides a contrast between the EMH and AMH. If risk premiums and asset volatilities remain constant, then portfolio weights are sufficient. However, if conditions in the market change over a period of time, then an adaptive strategy may be superior. Lo (2012) explains how the practical use of the AMH is more challenging than the idea behind the traditional investment theory. Furthermore, these challenges can be improved by making use of trading technologies and algorithms, lower trading costs, better statistical measures of time-varying parameters using various online data sources, the greater liquidity of exchange-traded index futures and other derivative securities, and better-educated investors and portfolio managers. Due to the complex nature of the global economy, individuals need to learn and adapt by applying more effective financial technologies.

ii. Critique on the AMH

The AMH and EMH are both built on the idea that individuals act in their own self-interest. In terms of investor mistakes and adapting to mistakes, the AMH argues that investors also make mistakes and they are capable of learning from these mistakes by adapting future behaviour accordingly, this conflicts with the theory of EMH. In efficient markets there are no investor mistakes, nor is there learning or adaptation as markets are static and always in equilibrium. Secondly, EMH argues that arbitrage opportunities do not exist due to the fact that security prices do not reflect any mispricing. Contrary to the EMH, the AMH model states that arbitrage opportunities do exist from time to time and that when these opportunities arise, they are exploited and disappear.

Thirdly, according to AMH, investments undergo alternate increases and decreases, these investment opportunities may decline but return in the future. This contradicts the EMH which states that investment opportunities would be completed away. Fourthly, EMH argues that certain levels of expected return can be attained by simply bearing a sufficient degree of risk. This conflicts with AMH, as the AMH states that the relationship between risk and rewards varies over time. The AMH states that an alternative approach to achieve certain levels of expected return is by adapting to changing market conditions.

Fifthly, the EMH is "fast" in terms of the time it takes for new information to be reflected in the stock price. AMH differs from EMH in this regard; as AMH attempts to find common ground between EMH and Behavioural Finance in terms of the speed in which stock prices reflect new information. Lastly, unlike the EMH that assumes a frictionless market, AMH accommodates market frictions and asserts that markets evolve over a period of time, as AMH asserts that the laws of natural selection or "survival of the richest" determine the evolution of markets and institutions in real-world markets, which have frictions (Hiremath & Kumari, 2014).

The Random walk hypothesis is a subset of the Efficient Market Hypothesis, it assumes that prices follow a random walk, thus changes in prices cannot be predicted, and this is consistent with the weak form of EMH. Warren Buffet along with a limited number of investors who were able to beat the market consistently, in the long run, utilizing different investment strategies. Non-believers of the random walk hypothesis have found that while complete price change predictability may not be possible, the opposite, total randomness in price movement, fails to be true as well.

Lo & MacKinlay (1987) compiled a simple specification test based upon variance estimators. The study consists of asset price memory in the short- and long-term in 44 economies, including both emerging and industrialized nations. The findings of the study reveal that markets with a poor Sharpe ratio are more likely to reject the random walk as opposed to better-performing markets. In other words, markets yielding lower returns for a given risk level are more likely to be predictable compared to markets yielding higher returns. This study does not completely negate the random walk hypothesis; it does give food for thought on the total validity on the Random Walk Hypothesis.

2.7. The Arbitrage Pricing Theory

The Arbitrage Pricing Theory suggests the expected return-beta relationship as the CAPM. Ross (1976) through the Arbitrage Pricing Theory concludes that there is more than one risk factor which deviates from CAPM. APT does not require the identification of the market portfolio in its assumptions which partially attempts to address the problems of the CAPM. This model seeks to identify major component systematic risk factors of market risk that determine variations of asset returns in an efficient market. Identification of the factors' power assists investors when determining security returns. The expected return-systematic risk relationships in shown in Equation 1 where

$$E(R_i) = R_f + b_{i1}\{E(R_{F1}) - R_f\} + \ldots\ldots\ldots + \{E(R_{Fk}) - R\} \quad (2.1)$$

Where

Fk: (1,2 … n) number of the factor

E (ri); The expected return on asset i.
Rf: The risk-free interest rate in government bonds
E (RFk) – Rf: The risk premium of the factor
ƅik: Asset beta sensitivity to different risk factors

APT gives investors and companies the opportunity to identify various attributions of security returns and their relative importance in determining security returns. The law of one price underlies the APT, meaning, two securities that bear the same level cannot sell at different prices. Thus, when the law of one price is violated, there will be arbitrage opportunities allowing investors to earn riskless profits with zero investments (Hodnett & Hsieh, 2012). APT proposes that any investor can take infinite positions in an opportunity to bring about capital market equilibrium, compared to CAPM which gives limited positions. Moreover, APT gives recognition that the unanticipated part of the return results from surprises is the only relevant risk of an investment.

APT's main advantage is dependent on the fact that it allows investors to specifically tailor their portfolios to their preferences and circumstances by adjusting the exposure to individual risk factors. Contrary to CAPM, it argues that different investors could have portfolios with similar CAPM beta but have different exposures across various risk factors. Thus, Roll and Ross (1984) highlight that the most essential role of strategic portfolio management is decision making on the most desirable exposures to various systematic risks for clients. Overly, APT promotes this role by permitting investors and portfolio managers to segment portfolio risk and to actively manage portfolios through predicting movements in critical risk factors. In efficient markets, profitable arbitrage opportunities will quickly disappear. Investors' want to exploit the price differences in equities which result from market inefficiencies.

i. Passive and Active investing strategies

Over the years the debate has continued in the South African equity market around passive and active investing strategies. Each investor has individual goals, wealth availability, needs and risk tolerance which guide his or her investment decisions. Thus, proponents of most strategies include risk guidelines, buying or selling strategies and asset allocation. Passive investing involves the purchase and hold (in a benchmark index) strategies while diversifying with any efforts to find mispriced securities. The goal is to establish a well-diversified portfolio of equities without trying to beat the market. Investors do not look above or below the SML for overvalued or undervalued securities. Thus, EMH assumes that securities are fairly priced, and proponents believe that with all relevant information is available in the price, therefore, there is no need to frequently buy and sell securities because it increases brokerage fees without actually cumulating expected performance (Bodie, et al., 2012). Thus, it is better to be passive than spending resources in a fruitless effort to outwit your competition in the financial markets. Moreover, passive strategy allocates portfolio similar to a market index and applies a similar weighting as that index with the objective of generating similar returns as the chosen index. Many investors believe that passive strategies make sense.

Assuming the SA market was completely efficient there would be no need from active security analysis, only fools would commit resources to actively scrutinizing securities. However, without continuous security analysis prices would depart from their 'correct' values, thereby, creating new incentives for asset and money managers to move in. Passive management believes that strong competition amount skilled fund managers might certainly force security prices to levels at which further security analysis is unlikely to turn up substantial profit opportunities. Some suggest 'neutral' diversification approaches to avoid the costs of acquiring information on any individual or group of securities.

On the contrary, active investing strategies attempt to identify mispriced strategies or forecast broad market trends (i.e. by timing the performance of broad asset classes). Therefore, this involves frequent purchasing and selling actions by the investors. Supporters of EMH view active investing as a waste of effort and its justification of incurred expenses is questionable. Active strategies employ some practices of intra-market analysis to identify particular sectors of the market or securities that are relatively mispriced. Active managers are dependent on analytical research, forecasts, and their own judgment and experience in making investment decisions on what securities to buy, hold and sell. To them, they can potentially profit from any number of strategies that aim to identify mispriced securities. Asset management companies and money managers believe it's possible to outperform the market. They want to earn better returns than passively managed index funds. Unfortunately, it is hard to beat the market no matter how proficient the manager is. Thus, the expertise, experience, flexibility, skill, and judgment of the money or asset manager are fundamental to active management. Thus, if a manager is an expert in the retail industry, they may possibly beat the benchmark returns by investing in a select group of retail-related stocks that the manager believes are undervalued. Unlike passive investors who believe in long-term appreciation, active investors will typically look at the price movements of their stocks many times a day. Characteristically, active investors are seeking short-term profits. They are able to buy acquire and sell when they see it fit to make it possible to offset losing investments with winning investments.

2.8. Alternative Asset Allocation Techniques

Fundamental Anomalies

Systematic risk is not because of one source, but it is derived from the uncertainties in many macroeconomic factors such as inflation and business cycle risk. Multifactor models allow for the incorporation of several systematic factors which can provide a better description of security returns. These models give a wealthier means for security analysts and investors to think about risk exposures and compensation for risk exposures taken that the CAPM. Alternative approaches have been created on empirical grounds with characteristics to proxy for exposure to systematic risk. Factors chosen as variables based on past evidence seem to predict high average returns and therefore might be capturing risk premiums. The risk exposures that have been documented are Value (Basu, 1977; Size Banz, 1981) and momentum (Jegadeesh & Titman, 1993).

2.8.1. Value effect as a market anomaly

Basu (1977) agreed with EMH but came to a different conclusion than CAPM. He presents evidence arguing that the single factor pricing model does not describe the equilibrium for assets expected risk-return relationship completely. Adopting the price-earnings (P/E) hypothesis in his study, which states that prices of securities are biased, and P/E ratio is an indicator of such bias. Basu aims to identify an asset's performance in relation to its P/E ratio and states that according to the P/E hypothesis low P/E assets tend to outperform high P/E assets. Where P/E measures investors' sentiment of the future expected earnings. Thus, a high P/E indicates investor optimism about future earnings vice versa for low P/E assets. Findings based on the data set consisting of 1400 industrial assets from the NYSE conclude that over the 1956-1969 period, assets with a low P/E collectively averaged a return between 13.5%-16.5% alternatively high P/E assets earned between 9.3%-9.5percent.

2.8.2. Size effect as a market anomaly

Banz (1981) examined the relationship between the total market value of the common stock of a firm and its returns (the proxy for market value used is the market capitalization). He investigated three types of indexes on the New York Stock Exchange (NYSE) over a 40 – year period (1936 – 1975). Banz found that the small market capitalization firms achieved on average higher risk-adjusted returns compared to larger market capitalization firms, this phenomenon is known as the size effect anomaly. The methodology Banz used included the generalized asset-pricing model that used beta (ß) as a risk measure. In addition, he grouped individual securities of the NYSE into portfolios based on their market value and security beta (where large Cap shares have a higher beta compared to small-cap shares). Then, he performed Fama and Macbeth (1973) ordinary least squares regressions (OLS) and Black and Scholes (1974) generalized least squares regression (GLS) methods. Furthermore, an arbitrage portfolio was constructed consisting of shares of very large market caps and very small markets caps, a time series regression was then run on this portfolio to determine the difference in risk-adjusted returns between small and large firms.

Banz findings indicate that shares of firms with a larger market value had lower returns than smaller firms. The regressions conducted against beta on the grouped portfolios indicate that the residuals contain information about the size effect. The smaller firms have on average very large unexplained mean returns. Banz (1981) found that the size effect is not stable throughout time and sub-period analysis shows substantial differences in the magnitude of the coefficient of the size factor

2.8.3. Momentum effect as a market anomaly

Jegadeesh and Titman (1993) investigated the momentum effect on the NYSE and AMEX over an examination period of 1965-1989 using relative strength strategies and regression tools. The authors investigated the trading strategies that buy past winners and sell past losers. The investigation included the effect of earnings announcements on stock returns. The stock returns were arranged in ascending order and divided into 10 deciles. Based on these rankings the authors labelled the top decile as "losers" and the bottom decile as "winners". Furthermore, the authors investigated the relative strength of the returns provided by the winner and loser portfolios using simple return-generating modules that enable the authors to dissect excess returns provided the portfolios.

The first model used, included systematic risk factors (beta) and a component related to firm-specific returns. The second model included a lead-lag relationship, which used a simple one-factor model. Jegadeesh and Titman (1993) found that the beta of the past loser portfolios was higher than the betas of the past winners, which resulted in a negative beta for the zero-cost winner minus loser portfolios. Using market capitalization as a systematic measure Jegadeesh and Titman (1993) found that the highest and lowest past returns portfolios consisted of smaller than average stocks.

Jegadeesh and Titman (1993) state that trading strategies that buy past winners and sell past losers experience significant abnormal returns over the 1965-1989 examination period. Stocks that were selected on a short-term horizon based on their past 6- months returns and were held for 6 months experienced a compounded excess return of 12.01% per year on average. The returns of the zero-cost winner minus loser portfolios were examined over a 36-month period; these portfolios generated positive returns in each of the 12 months after the formation date. Thus, short-term momentum is the predisposition of stocks that have been performing well, keep outperforming the losers and the market in the future after portfolio formation. However, the longer-term performance of these past winners and losers reveal that half of their excess returns obtained in the first year after formation dissolves within the following 2 years. Furthermore, the returns of the winner and loser portfolios around the time of the earnings announcement in the 36 months following the formation period were also studied and a similar pattern was observed. Stocks in the winner portfolio had higher relative strength returns than stocks in the loser portfolios the first 7 months after earnings announcements were made. However, the authors discovered that returns based on the earnings announcement in the 8-20 months following formation are significantly higher for stocks in the loser portfolios relative to the returns of the winner portfolios.

2.8.4. Profitability efficiency as a market anomaly

Profitability is describing as a firm's ability to generate earnings as compared to expenses. Accounting ratios are mostly used to measure profitability which includes return on assets, gross profits-to-assets, return on capital employed and return on equity. The ratios that measure profitability provide different insights into the firm's financial health. Gross profits are the 'cleanest' accounting measure of economic profitability even after controlling for valuations. Gross Profitability represents the other side of value and gross-profits-to–assets has approximately the same power as book-to-market predicting cross-sectional average returns, Gross profits Gross profits-to-assets and book assets and book-to-market negatively correlated (Novy-Marx, 2013). Profitability predicts economic growth and profitable firms are extremely dissimilar from value firms. More profitable firms significantly outperform less profitable firms. Novy-Marx questions the relevance of profitably on Asset Pricing. They raise the point that the data must be clear and definite to answer the empirical question. Thus, FF simple time regressions identity profitability and investment positions as anomalies. Some anomalies might be taking positions in profitability but does not explain why profitable firms outperform in the first place. An approximate but not ultimate explanation of the anomalies can be derived from the power of gross profits-to-assets. Novy-Marx (2013) conclude that gross profitability is a powerful predictor of the cross-section of average returns. It can be obscured by its negative correlation with Book to Market.

2.8.5. Investment Factor as a market anomaly

The new "investment" factor has a high correlation to the value and profitability factors. The investment effect is perhaps half as strong, but it is still reliable and significant. Surprisingly, when you statistically analyse the performance of stocks, the value factor completely drops out of the equation and can be replaced by the beta, size, profitability and investment factors. At a distance, value gives you a quick and dirty approximation for beta, size, profitability, and investment. But up close and personal, once you take beta, size, profitability, and investment into account, value isn't bringing anything new to the hootenanny.

2.9. Conceptual Framework

Figure 8: Conceptual Framework (Source: Compiled by the author)

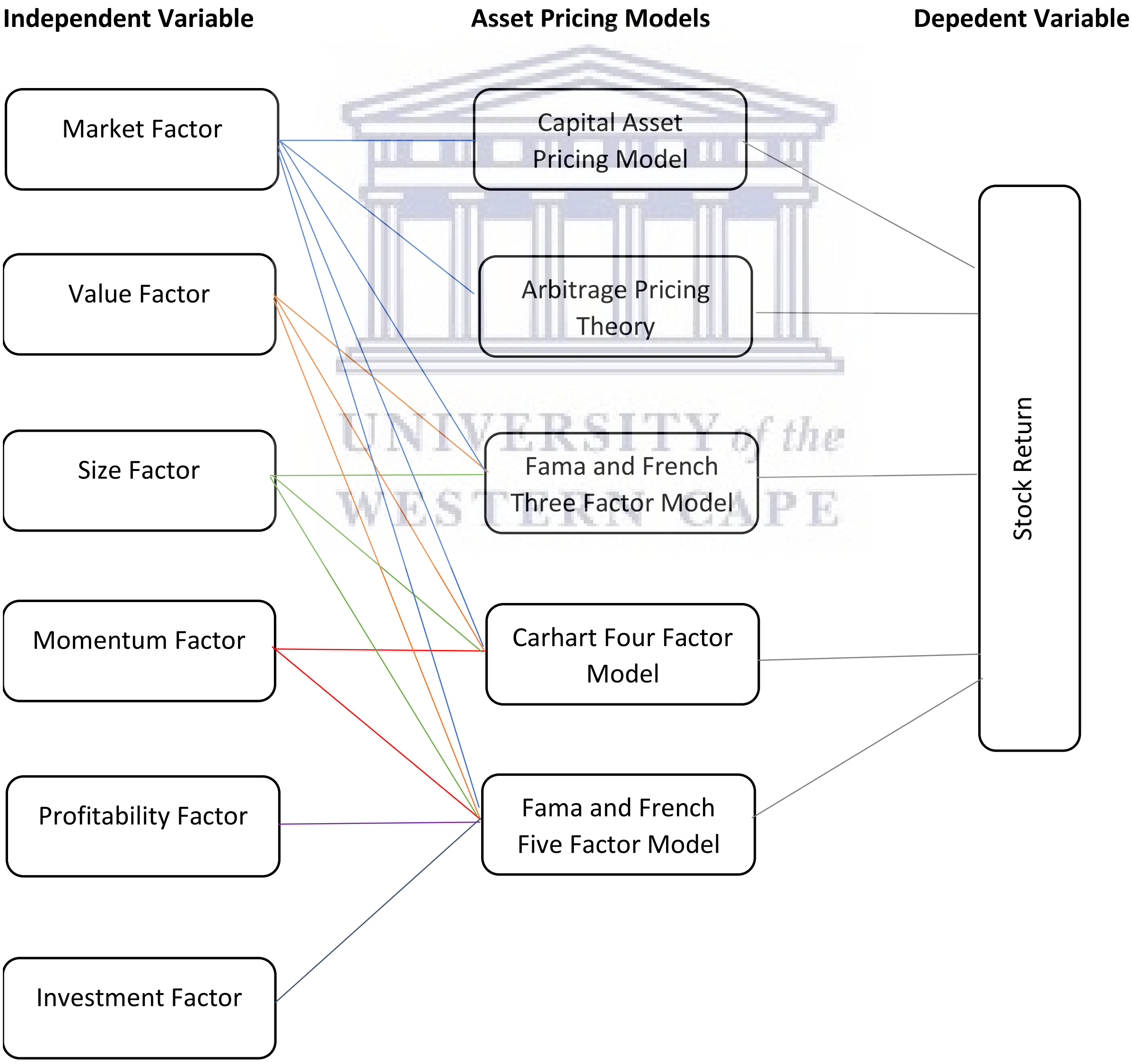


Figure 8 presents the conceptual framework that the researcher has adopted to guide the efforts and structure of the research study. Although the main focus is on examining the effects of the of style-

based risk factors on the performance of securities on the different sectors, the viewpoint of the framework is that much of what happens to the stock returns is shaped by the market risk factors and segmentation present on the JSE. The independent Variable consists of the main risk factor being investigated in this study, including market, value, size, momentum, investment and profitability. The models used to test the presence of the market anomalies are presented as independent variables. For this study, it should be mentioned that the emphasis is on style-based risk factors.

2.10. Chapter Summary

One of the most fundamental issues in finance is the basic relation between risk and return. This remains murky over fifty years. Many have dredged frameworks, but much remains unexplained. The theoretical sense as explored in this chapter, on one hand, believes that through the CAPM it is possible to predict however other theories formed later dispute this fact. This led to the improvement of the factor models. The Fama-French five-factor model which added two factors, profitability, and investment, came about after evidence showed that the three-factor model was an inadequate model for expected returns because it's three factors overlook a lot of the variation in average returns related to profitability and investment.

This chapter reviewed the Capital Market Theories that underlie the framework for this research study. This includes the implications of the Morden Portfolio Theory, the CAPM, the AMH and the APT. This included also included the criticism of the CAPM and the AMH. The EMH and the pervasive influences of Behavioural Finance on Capital markets were examined. For investors and financial practitioners what would be useful tools would be models that practical explain the relationship between risk and return in the South African context. Models that explain in different economic conditions. This study with the guide of previous research attempted to test the models currently there and this report attempted to test how well these tools fit the data relative to the traditional CAPM and the factor models. Chapter Three provides an in-depth discussion on the pertinent existing empirical literature advocating the existence of style-based anomalies tested in this study.

CHAPTER THREE: BRIEF REVIEW OF RELATED LITERATURE

3.1. General Overview

All investors, researchers, asset managers, and financial analysts have attempted to come with a model that would be able to explain the stock market returns. The ability to fully explain expected returns would give investors a better method to enable them to predict how securities will perform in the near future. Arguments over time have been presented by researchers on which strategies based on past stock returns have the power to explain future stock return. Since 1965, asset pricing models increasingly became prominent and many researchers have been testing them. These models continue to grow because there is always a need for methods of evaluating investments and show the relationship between expected returns and risks. The most famous model is the Capital Asset Pricing Model. This brought about many arguments and the promulgation of the many other models thereafter, to the most recent, the Fama and French Five Factor Model. The CAPM explains cross-sectional returns with only a single risk factor which cause the many arguments against the model. This led to anomalies which commonly known as security behaviours that cannot be explained by this single factor model. The asset pricing models have increased from empirical validity tests of the CAPM. Developed and developing economies have produced different results which require further investigations. A single factor, beta, alone is not enough even in South Africa is not a variance in stock returns. Over time models with additional risk factors, anomalies, namely, value, size, momentum, profitability, and investment most notable.

The chapter continues from chapter two by discussing reviewing empirical studies on stock market anomalies. This chapter aims to set forth the case for the predictive ability of the CAPM but with more emphasis on advocating the existence of style-based anomalies tested in this study. This was achieved through exploring the single and multifactor asset pricing models observed in both the South African market, and the developed and emerging stock markets. Finally, this chapter ends with the summary which included the gaps that were identified in the literature reviewed and concluding remarks.

3.2. Empirical Literature

3.2.1. Objective One: Predictive Ability of the CAPM

Van Rensburg (1997) uses monthly share return data during the period between 1980 and 1989 to consider the implication of market segmentation for applying linear factor models of the JSE. In this paper, the nature of linear factor models is discussed. One of the analytically extracted factors showed that it was able to significantly explain the cross-section of returns, therefore, justifying the inclusion of LFM underlying the APT. This study supports the contention that there exists a cleavage in the economic forces underlying returns on the mining and industrial sectors of the JSE.

Bowie & Bradfield (1998) conduct research into the beta estimation concerned with two phenomena's which impact on the traditional estimation procedures which are the severe thin trading evident on the JSE and the perceived separation between the industrial and mining sectors of the JSE. They outline that other researchers have also attempted to determine whether the world markets are integrated or segmented, but, have only come up with evidence which supports mild segmentation implied by the existent investment barriers (Stulz, 1981; Errunza & Losq, 1985; Black, 1974). They found additional evidence of the apparent market segmentation between mining and industrial sectors of the JSE exposed in the pricing of securities.

In a diplomatic forum report, former Governor of the SARB Tito Mboweni (2000) noted that globalisation and technology advancement has made it easier for the national market to be globally integrated. Noteworthy is that he notes that elimination of obstacles encouraging free trade and greater financial market integration has led to greater market efficiency and improved risk-return combinations for investors. The SA stock prices are increasingly influenced by the international investors and developments in New York, London, Tokyo, and Frankfurt. Noteworthy, the opening of the SA market suggesting that the effects of disruptions in the international market could be felt in the country. The Asian crisis in 1997 and 1998 occurred because economic liberalisation was felt in the country.

South Africa is a country divided by race, language, culture and ethnic groups. The advent of democracy in South Africa opened the market to new sources of capital flows and developing institutional structures to enhance development. Piesse & Hearn (2002) investigate the extent to which markets are integrated or segmented in three dominant markets namely Botswana, Namibia, and South Africa. They find that South Africa is a much larger market with greater access to global capital markets compared to the other countries. A general view is taken that the positive development in the Southern African region has seen market integration taking place. Thus, the strengthening of transparency, increased coordination, harmonization of listings requirements, stronger financial regulations and evidence of good governance are hugely beneficial to the effectiveness of the stock markets.

Moreover, it can be noted that South Africa is not immune to the effects of globalisation and the integration of financial markets. Kabundi and Mouchili (2009) investigate the extent to which South African returns are linked to the developed as well as developing countries. The attempt to identify the sources of common fluctuations in stock returns. From thereon, measure what percentage of the JSE All Share index is explained by world common factors. They employ the Dynamic Factor Model and CAPM to assess the degree of integration as their models for the tests. They find that world return explains 55% of the variance of SA stock returns which is consistent with emerging economies. Adding on, the study shows that 45% of changes in SA returns are explained by regional or country-specific factors. They suggest that a country needs to understand thoroughly policy implications of integration in the national and global economy, hence, as it impacts future developments.

There have been many tests on the validity and predictive capabilities of the CAPM over the years. Ward and Muller (2012) re-examine South African data from 1985 to 2011 for evidence often association between beta and returns. They use a refined methodology to estimate betas using for methodologies and form five equal weighted quintile portfolios ranked by betas reviewed quarterly. The study also examines the characteristics of the beta ranked in quintiles over the time-series. They find a positive correlation between beta and size, and resources, a relative correlation between beta and price to earnings yield, and no relationship between beta and the price to book ratio. These findings render the use of CAPM as a single parameter redundant. Overall, the results of this study by Ward & Muller (2012) supports findings by Fama and French (1992, 2004), van Rensburg & Robertson (2003) and Strugnell, Gilbert and Kruger (2011) which show that in contradiction to the CAPM, beta and returns have an inverse, monotonic relationship. They show that momentum and value are present and significant on the JSE, however, they find no evidence of size effect. Thus, over the 26 years the first they find momentum constructed using an estimation period of 12months with a holding period of 3months produces the highest excess return of 18.6% per annum on average.

Nel (2011) investigated how well the valuation theory regarding the CAPM in particular, as advocated for, by academia, is aligned with the CAPM and alternative models that leading financial analysts and corporate financiers apply in practice. This study aimed to identify if there is a gap between the cost of equity in South Africa to that calculated by financial analysts and investors to that advocated by academics. Practitioners agree on the use of CAPM and beta. This study highlights that service providers disagree significantly on the use of APT, the choice of an appropriate risk-free rate (Rf) and adjusting the risk-free rate for tax purposes.

Systematic risk captures aspects of investment risk which cannot be eliminated through diversification and the higher the systematic risk (beta). In a study on ten sectorial indices listed on the JSE Securities Exchange from 30 June 1995 to 30 June 2009, Reddy & Thomson (2011) examine the validity of the CAPM in the South African market. Emphasis is on the relation between return and beta and the question of whether CAPM explains excess returns. The highlights that CAPM's empirical problem may be a result of its simplified assumptions and difficulties in implementing valid tests of the model, hence, results might not be completely conclusive. They settle that CAPM could be rejected on certain periods on the assumption that the residuals of the return-generating function are normally distributed; the use of CAPM for long-term modelling in the South African market can be reasonably justified. Moreover, zero beta version supports the relative SML observed in this study and literature.

In a follow-up study, Thomson & Reddy (2013) increase the sample size as suggested in the previous study from 30 September 1964 to 31 December 2010 and quarterly total returns from the FTSE/JSE all-share index listed on the JSE Securities Exchange were used, together with yields on government bonds and consumer price indices over the same period. This investigation also tested the predictions of the CAPM in real terms for the South African market. Thomson & Reddy (2013) concluded that for real quarterly returns on a South African market portfolio comprising equities and bonds, the zero-beta version may be accepted for the period since 1989 using either prior betas or in-period betas. If it can be assumed that later years represent the status quo, it would be reasonable to use the zero-beta version of the CAPM for the stochastic modelling of real returns on investments. Therefore, assuming normal distributions and the rational-expectations hypothesis, the standard version of the CAPM must be rejected. Regression tests both zero-beta and standard versions of the CAPM were made, using both prior betas and in-period betas. Hotelling's test was also applied, as well as regression analysis. These tests were made for individual periods as well as for all periods combined.

In the Hungarian Capital Market, Andor, Ormos, & Szabó (1999) examine the CAPM using monthly data of 17 Hungarian companies listed on the Budapest Stock Exchange over the period July 1991 to June 1999. They conclude that CAPM acceptably describes the Hungarian Capital Market, but, a weaker depiction of the reality comparing the same results with markets with a great past. There is segmented investing behaviour between international and domestic investors which could be the cause of strange results. It is difficult to determine if the effect of segmented investors; application of data correction; presence of too few data or the undeveloped domestic capital market causes moderate results obtained by CAPM.

David Wakyiku (2010) examined the validity of the CAPM on the Ugandan Stock Exchange (USE) using monthly stock returns from 10 companies between the period March 2007 and November 2009. At the time of the study the USE had only been in existence for 10 years and Uganda is an emerging economy. The traditional form of CAPM holds on the USE, however, the beta coefficient does not offer a good explanation about the relationship between return and non-diversifiable risk on the stock exchange. The findings of this study are consistent with the fact that most emerging markets are characterized by low risk.

Bhatnagar and Ramlogan's agenda in their 2012 paper was to provide an out of sample test for the TFM in the UK market over the period 2001 –2007 and to empirically scrutinize whether the market beta of the full period CAPM and split-sample CAPM can explain observed value premium effects for the UK market. Evidence provides support for the Fama and French three-factor model and its superior ability over the CAPM to explain returns and value premiums. The three Factor Model outperformed CAPM on all full period CAPMs in explaining UK stock market returns. It suggests that investors who hold stocks in firms with large market equity generate superior returns (2012). This result challenges the findings of Fama and French (1993, 1996) that identify small firm effect findings for the US Market. This study also shows that investors who invest in value stocks will generate higher returns than those who hold growth stocks. This result has implications for investors and portfolio managers who maintain the use of the traditional full period CAPM.

Bhatt and Chauhan (2016) examined the validity of the CAPM on the Indian stock market. A sample of top five performing companies according to their market turnover was selected out of the 30 companies of BSE Sensex for a period of five years from 2011 to 2015. Daily returns were used to find their beta. The results indicate there is a difference between CAPM returns and Actual returns observed in the stock market which had been a result of undervaluation and overvaluation of stock. Moreover, the study exhibits evidence that contradicts the basic assumption that higher beta will lead to higher returns. Hence, the study finds no influence of the CAPM on market returns which conforms non-applicability of CAPM on the selected sample for the duration examined.

3.2.2. Objective Two Multifactor Asset Pricing Models

Empirical contradictions of the CAPM by Sharpe (1964) led to a study by Fama and French (1992) which focused on the risk and return relationship. They propose a multi-dimensional model because the prior considers beta only as the risk factor even though it does not support beta suffice measure to describe cross-sectional returns. Their study emphasizes that Size effect Banz (1980) and Value Effect Basu (1977) as the two additional dimensions to the CAPM. These variables provide a simple, yet, meaningful explanation of the characteristics explaining the cross-sectional return of shares, over the period of study 1963-1990.

In a follow-up study Fama,(1993) the study conducted a time series regression with three independent variables known as the FF3FM this included the market factor (MRP), size factor (SMB) and the value factor (HML). The aim of the model was to conclude whether these factors can explain differences in shares average returns. Fama, (1993) states that results from the cross-sectional study in 1992 on the value factor and size factor are conclusive; however, the market factor plays a dominant role in explaining average returns as well. By eliminating two major anomalies (the outperformance of small stocks and value stocks), it improved the model's explanatory power from about two-thirds of the differences in returns of diversified portfolios to more than 90%.

Carhart (1997) added a very important fourth factor which greatly enhanced the explanatory power of the three-factor asset pricing model. This improvement was necessary but the battle of the factor models. This intensified after the Novy-Marx (2013), proposed a fifth factor, profitability. This added factor suggested outperformance of stocks with higher profitability. This factor also improved explanatory power. Hou, Xue, and Zhang (2014) proposed a new factor model, thus, the Q-factor model which included market beta, size, investment, and profitability, and went a long way to explaining many anomalies.

This significant advance in profitability together with investment led the Fama and French five factor model. In 2015, Eugene Fama and Kenneth French proposed a new five-factor model, using their original three factors and adding somewhat different definitions of investment and profitability. Robert Stambaugh and Yu Yuan, authors of the January 2016 paper "Mispricing Factors," add to the literature by proposing another four-factor model that includes two "mispricing" factors in addition to the factors of market beta and size. The authors note: "Factor models can be useful whether expected returns reflect risk or mispricing." Stambaugh and Yuan's approach was motivated by the fact that "anomalies in part reflect mispricing and that mispricing has common components across stocks, often characterized as sentiment. A mispricing interpretation is consistent with evidence that anomalies are stronger among stocks for which price-correcting arbitrage is deterred by greater risks and impediments." This is often referred to as limits to arbitrage. Now we have a new four-factor model that incorporates anomalies and appears to have a greater ability to explain the differences in returns of diversified portfolios than some prominent alternatives. Some evidence of persistent large cap share outperformance was displayed.

Motivated by the Dividend discount model Fama and French (2014) find empirical evidence to strongly support profitability and investment effects in asset returns. Fama and French rearrange the DDM and gather three factors from it that should predict stock prices today. Theoretically, the DDM states that the value of the stock today is dependent upon future dividends. This procedure for valuing stock which predicts stock prices today and pronounces that the market value of one stock today will be the sum (the discounted present value) of all its future dividends. Hence, they propose a new five factor models which added two new factors, profitability, and investments, to the classic FF3FM (1993) after evidence showed that the FF3FM was an inadequate model for expected return because it overlooked a lot of the variation in average returns related to profitability and investment (Fama & French, 2014). Using the US market to test the performance of the five-factor model Fama and French use data over 50years from July 1963 to December 2013. The empirical tests of the five-factor model aim to explain average returns on portfolios formed to produce large spreads in Size, B/M, profitability and investment.

Firstly, the model is applied to portfolios formed on size, B/M, profitability and investment. The portfolio returns to be explained are from improved versions of the sorts that produce the factor. Secondly, the five-factor model's performance is compared to the three-factor model's performance with regards to explaining average returns associated with major anomalies not targeted by the model (Fama & French, 2014). The regressions observe whether the FF5FM captures average returns on the variables and to grasps which variables are positively or negatively correlated to each other and how all these factors are related to and affect average returns of stocks values. Fama and French's tests (2014) show that the value factor HML becomes redundant for describing average returns when profitability and investment factors have been added. The results also show that the FF5FM explains between 71% and 94% of the cross-section variance of expected returns for the size, value, profitability and investment portfolios. It has been proven that a five-factor model directed at average stock returns performs better than the FF3FM in that it lessens the anomaly average returns left unexplained. The new model shows that the highest expected returns are attained by companies that are small, profitable and value companies with no major growth prospects (Fama & French, 2014).

The main setback of the FF5FM is its failure to capture the low average returns on small stocks whose returns perform like those of firms that invest a lot in spite of low profitability as well as the model's performance being indifferent to the way its factors are defined (Fama & French, 2015). Also, the model fails to capture low-average returns on small stocks with high investment and low profitability. The five-factor model has yet to be proven as an improvement compared to previous models however it has left room for better models to be further developed from it in the future. Most investors still use the famous three-factor model but as methods seem to take some years before people start using, as industry personnel always have doubts. Looking at the practical work done and shown by Fama and French it seems it would be in the best interests for investors to use the other factor models until this method proves itself in the empirical evidence.

Huang (2016) reviews the FF5FM and attempts to address and provide a detailed discussion some important issues and problems in capital asset pricing that are becoming substantial topics for academic and practical research into the future. There are some questions and limitations raised on the FF5FM and its method which are noteworthy for future researchers. To begin with the results, they show that the highest returns can be expected from businesses that not embarking on major growth initiatives but are small, value firms, and profitable. Thus, it is favourable and interesting to examine whether this phenomenon shows up in international data. EMH infers that all information is already assimilated into the stock prices; however, in practice is it good or bad news for the securities if a firm announces its intentions to invest large amounts of money into a new project. It is essential to note the reactions of investors whether they will sell or buy the stocks of that particular firm.

Secondly, it must be noted this study does include liquidity and momentum effects. On the one end, Carhart (1997) portfolios formed show that including momentum factor is imperative. However, on the other end, Racicot and Rentz (2016) have evidence to suggest all factors including liquidity are not significant at even the 5% level using their approach except market factor. They test the five-factor model and indicate that it seems quite effective in explaining the returns through the method of ordinary least squares. However, the explanatory power of this model substantially weakens when using the generalized matrix method, not excepting liquidity. To end, the low average returns of small stocks that invest a lot despite low profitability are a potential problem that must be confronted. Future search should shed more light on this issue whether the phenomenon exists in emerging countries.

It should be noted that if the indicators profitability and investments are to be utilized to evaluate their impacts between risk and stock returns, particular attention must be given to distinguish investors to use this method depending on the nature of the application. Haung (2016) suggests that the FF5FM has improved greatly in the direction of launching itself as a major field of asset pricing models and it presented a favourable area for further investigation.

Scher & Muller (2005) study unit trusts with a particular focus on determining the style adjusted performance persistence of unit trusts. They find that once exposure to the market, size and value were taken into account for the most part South African funds were unable to outperform the market. Small cap and value fund exhibited negative performance persistence that that extended at least over 2 years. Small company unit trusts were persistently outperformers with value following in line. The competition to find superior models is what helps advance our understanding not only of the markets but of our understanding about which factors to focus on when selecting the most appropriate investment vehicles and developing portfolio. (Swedroe, 2016) Research by means of cross sectional and time series analysis has uncovered superficial anomalies with CAPM and EMH. These anomalies have been expanded and replicated in the extensive body of research in numerous markets, with the most prominent, including value effect (Basu, 1977), size effect (Banz, 1981) and momentum effect.

Relevant studies have been conducted on emerging and developed markets to investigate the very existence of value, size, and momentum (Cakicia, Fabozzi, & Tana, 2013) (Fama & French, 2012). Fama and French (2012) investigated size, value and momentum stock returns in four regions, namely. North America, Europe, Japan, and Asia Pacific. They find the presence of value premiums in average return in all four regions and evidence of strong momentum in all regions except Japan. In addition, this evidence shows that international value and momentum returns vary with firm size, this, excludes Japan where value premiums are larger for small stocks. In Japan, there is no evidence of momentum returns in any size groups and the winner minus loser spreads in momentum decrease from smaller to larger stocks. Global asset pricing models in tests fail to explain regional returns, thus, motivates local models for three regions (North America, Europe, and Japan), hat use local explanatory returns provide passable descriptions of local average returns for portfolios formed on size and value versus growth. The local models are less successful when capturing size and momentum.

Furthermore, Cakicia, Fabozzi & Tana (2013) using stock level data from January 1990 to December 2011 investigated value and momentum effects in 18 emerging stock markets (namely, Latin America, Eastern Europe, Asia and All-emerging which included all 18 emerging countries together). Strong evidence of value effect is found in all emerging markets. All four emerging regions except Eastern Europe have the momentum effect. This paper also investigates size patterns in value and momentum returns. On value effect, large stocks premia point estimates are slightly larger than small value premia. They find that the momentum effect decreases with size, which is a finding consistent with most developed markets. This study on emerging markets confirms literature that developed markets highlighted that momentum and value are negatively correlated. Turning to asset pricing models After forming portfolios sorted on size and book-to-market ratio, as well as size and lagged momentum well-known factor models, CAPM, Fama and French (1993) and Carhart (1997) four factor model, are used to explain the returns for these portfolios based on factors constructed using local, U.S., and aggregate global developed stock markets data. Local factors perform much better, suggesting emerging market segmentation.

In another study (Jiao & Lilti, 2017) investigate the explanatory power of profitability and investment factors on the Chinese stock market by comparing the FF3FM and FF5FM because of the lack of FF5F research outside US market. In the view of Fama and French, the value premium and size effect are related to the systematic patterns of profitability and growth which can be potential major sources of risk in return. They find that in the Chinese market FF3FM has less explanatory power than on the US stock market. Moreover, the FF3FM is able to capture more than 90% of time-series variation of average excess stock returns on Chinese A-share stock market during the research period. However, they find no significant improvement of FF5FM in comparing to FF3FM except for the six value-weighted Size-OP portfolios. They conclude that their results are inconstant with those of the US stock market and profitability and investment factors do not have much additional explanatory power.

On the other side, Chen, Novy-Marx and Zhang (2011) suggested an alternative three-factor model which consists only of the market factor, an investment factor and a return-on-equity factor in for explaining the cross-section of expected stock returns. Formally this is,

$$E[r_i] - r_f = \beta_{iMKT} E[r_{MKT}] + \beta_{iINV} E[r_{INV}] + \beta_{iROE} E[r_{ROE}], \quad \{3.1\}$$

In which,

MKT: the market excess return,
rINV: the difference between the return of a low investment portfolio and the return of a high investment portfolio,
rROE: the difference between the return of a high return-on-equity (ROE) portfolio and the return of a low return-on-equity portfolio,

E[MKT], E [rINV], and E[rROE] are expected premiums, and βiMKT, βiINV, and βiROE are the factor loadings of portfolio on MKT, rINV, and rROE, respectively.

This alternative model outperforms the traditional asset pricing models (CAPM, APT, FF3FM) that are associated with short-term price returns, failure probability, earnings surprises, accruals, net stock issues, and stock valuation ratios. They imply that this model is a good start to understanding capital markets anomalies.

Asness, Moskowitz, and Pedersen (2013) explore new insights into these value and momentum anomalies by examining their returns jointly across eight diverse markets (U.S, United Kingdom, Japan, and Continental Europe) and asset classes. They find comprehensive evidence on expected return premiums to value and momentum strategies in a variety of asset classes and uncover strong common factor structure among their returns. They also show that the combination of value and momentum effect provide better return premia than either standing alone. In addition, Asness, et al. (2013) find evidence from the data which suggests that there is a link between liquidity risk and the value and momentum phenomena

Investment style anomalies are common on equity markets and with growth and time, they become more frequent and persistent. Philpott and Firer (1994) examined securities on the JSE from 1866 to 1991 with the aim of evaluating the extent of anomalies' influence and efficiency of the JSE. They find that liquidity on actively traded shares explains some, but not all the price anomalies. The three factors that are likely to influence market efficiency are liquidity ration value ratio code (inability of investors to interpret information), and shareholder activity.

A study conducted by Strugnell, Gilbert, and Kruger (2011) on the JSE builds on the observations of Van Rensburg and Robertson (2003) who found persistence size and value (proxied by the price-earnings effects) in the cross-section of returns on the JSE. However, they establish that beta had, if anything, beta maintains a negative relationship with the expected return. They examined stock returns from January 1994 to October 2007 and found that beta has no predictive power for returns on the JSE, thus, invalidating the CAPM based on ALSI as the market proxy. The evidence of size and value effects indicates the market is inefficient. Size premium is concentrated on small stocks on the JSE with no significant difference in returns, better returns and over time the size premium diminishes. This unequivocally endorses evidence presented by Van Rensburg and Robertson (2003) that the CAPM is unable to explain the generation of returns on the JSE. Strugnell, Gilbert, & Kruger (2011) suggest that the construction of a multifactor pricing model based on these insights would be an important extension to the research.

Muller & Ward (2013) examine the potential benefits of styles and the persistence of several style-based strategies over the examination period between 1985 and 2011 on JSE share price data. In contrast, to other studies, there was no evidence of small size effect, but there was evidence that shares with larger market capitalization underperform. This study endorsed momentum as important because they found the persistent outperformance of the momentum style with a 3 months and 12-month holding period. A combination style that includes momentum, earnings yield and returns on capital and cash-flow to price gave the best results which persistently outperformed the ALSI by around 9% per annum.

Other empirical work to explain the effects of beta, size and value on South African equities were written by Strugnell, Gilbert, and Kruger (2011) building on the observations of Van Rensburg and Robertson (2003). Based on security returns from January 1994 to October 2007 the study confirms the evidence of size effect and value effect. Strugnell, Gilbert, and Kruger, (2011) conclude that beta is irrelevant as far as the generation of returns on the JSE is concerned. Size and value effect operate independently, and size effect diminishes over the sample size period which is consistent with the rational market participant closing out historical inefficiencies. This unequivocally endorses evidence presented by Van Rensburg and Robertson (2003) that the CAPM is unable to explain the generation of returns on the JSE.

Chinzara and Kambadza (2014) investigate whether anomalies exist on the JSE daily returns using daily closing prices data for the All Share Index and four indices that represent prominent sectors of the JSE, namely, FTSE/JSE indices of Industrials, General Retailers, Mining and Financials gathered from 01 January 1995 to 31 December 2010. In this study, unlike others, the market risk was estimated from aggregate domestic returns using an asymmetric GARCH model. They find that JSE daily returns seem to exhibit significant positive returns early in the week and significantly negative returns later in the week. The relationship between risk and return is in contrary to the portfolio theory in the latter days of the week. Thus, their findings show that anomalies exist on JSE on daily returns.

Kruger and Toerien (2014) using daily share price data for constituents of the JSE All-Share Index (ALSI) covering the period February 2000 to December 2009, investigated the return predictability with emphasis on the consistency of return predictability between a stable and market crisis period. The authors suggest that over the financial market crisis period firms with higher cash-flows are viewed by the market to be better poised to outperform during periods of crisis. Thus, firms with greater cash-flows relative to their price outperform during periods of market instability. It is interesting to note that statically significant factors in either period of crisis or stability are found to exhibit consistent payoffs during their respective periods of significance.

Style based risks influence on the JSE sector returns has been widely debated over the years. Graham and Uliana (2001) examined 58 companies listed on the JSE industrial sector from January 1987 to December 1996 to test the existence of the value growth effect in the South African market. Their study concluded during the period of study value effect had a more significant presence. A follow-up study was done by Bhana (2014) over the examination period January 1997 to December 2012 on 120 companies listed on the JSE. Bhana found that value portfolios outperformed growth portfolios constantly on a risk-adjusted basis Thus; investors who could beat the ALSI had Value securities.

van Rensburg (2001) using industrial shares on the JSE from 1983 to 1999 find earnings to price (value), market capitalization and past twelve-month positive returns (momentum). In another study, van Rensburg & Robertson (2003) found evidence that small size earns higher returns on the JSE, but small firms have smaller beta compared to the larger firms and found a price to earnings evidence. This evidence is in direct contradiction with CAPM showing that the model fails to explain variations on the JSE cross-sectional returns. In a study following up van Rensburg, Muller & Ward (2013) conclude beta coefficient as a single risk factor does fully explain security returns on the JSE although this study found only evidence of momentum, not size. Auret and Cline (2011) examine the interrelationship between price-earnings (P/E), size and the January effect using all ALSI constituents between 1988 and to December 2006 but found no significant support for the value and size effect anomaly on the JSE.

In order to provide a comprehensive answer on mean reversion on JSE Page and Way (1992) used a similar methodology to De Bondt & Thaler (1985). Over the examination period 1974 to 1989 they found evidence of mean reversion indicating that losers outperform winners. Muller (1999) follows up only to find that both winners and losers have a positive momentum effect but looser momentum quicker than winners.

La Grange and Krige (2015) investigate the profitability of momentum strategies on the JSE over a 15-year period between 1998 and 2013 on the ALSI top 40. They find that significant excess returns are present when investing long in the best performing and momentum combination strategies. Bolton and Von Boetticher (2015) used the study period 2009 to 2014, post the 2008 global financial crisis. They find that on the current data there are more negative results yielded on the indicators, therefore, no evidence of the momentum effect was observed on the ALSI top 40 effects or the reaction after the 2008 financial crisis.

Gustafsson and Lundqvist (2010) examined the existence and persistence of return momentum in the South African market between March 1995 and December 2009. This study explored three different momentum strategies, which are 3-month momentum with a 3-month holding period, the 6-month momentum with a 6-month holding period and the 12-month momentum with a 12-month holding period. This study also scrutinized their risk-return relationship under different market climates. The study made use of a single factor model and the FF3FM. The model finds momentum to be positive and economically significant in the South African market. Gustafsson and Lundqvist (2010) suggest that book-to-market ratio and firm size in combination with the market factor does a better job of describing cross-sectional differences in expected returns that the excess return of the market alone.

Lo and MacKinlay (1999) also found that there is some short-term momentum in stock prices and they rejected the hypothesis that stock returns took a random walk. Short-term momentum may also be attributable to investors' underreaction to information. Malkiel (2003) found that if the impact of new information is adjusted into the price of stocks over a period of time and not instantly, a short-run momentum and not randomness will be the result. Jegadeesh and Titman (2002) investigated short-term investment strategies. Short-term strategies are characterised by many transactions that are driven by short-term price movements because these strategies are built around taking advantage of these short-term price movements. They concluded that the success of these short-term investment strategies may imply short-term price pressure or a lack of liquidity in the market rather than underreaction to information.

Vardharaj and Fabozzi (2007) presented research on the segmentation of the markets in South Africa in which the findings indicate a positive relationship between sector allocation decisions and investment styles. Hence, the evidence of market segmentation and indexation of JSE influence the selection of the study on FINI, INDI, and RESI. Basiewicz & Auret (2010) tested the feasibility of the Fama and French three-factor model on firms listed on the JSE from June 1992 to July 2005 to explain the size and value effect. They propose that the three-factor model can be used to explain the value effect, and size effect and find that they persist after adjusting for liquidity.

The tests done by Fama and French (2014) shows that the value factor HML is redundant for describing average returns when profitability and investment factors have been added into the equation and that for applications were sole interest is abnormal returns, a four or five-factor model can be used but if portfolio tilts are also of interest in addition to abnormal returns then the five-factor model is best to use (Musarurwa, 2019). The new model shows that the highest expected returns are attained by companies that are small, profitable and value companies with no major growth prospects (Fama and French, 2014). The five-factor model's main setback, however, is its failure to capture the low average returns on small stocks whose returns perform like those of firms that invest a lot in spite of low profitability as well as the model's performance being indifferent to the way its factors are defined (Fama and French, 2015).

A model similar to the Fama and French five-factor model (2014) was developed by Hou, Xue, and Zhang (2014). This model was established for Tobin q-factor model consisting of the market factor, a size factor, an investment factor, and a profitability factor largely summarizes the cross-section of average stock returns. In capturing the remaining significant anomalies, the q-factor model did a good job.

The study of the Amman Stock Exchange over the period between 2011 and2015 indicate that there is a statistically significant effect of the common risk factors, excess market return (Rm-Rf), small minus big (SMB), high minus low (HML), robust minus weak (RMW) and conservative minus aggressive (CMA) on the cross-section of daily return.(Alrabadi & Alrabadi, 2018). In this study, the Fama and French five factor model fails to perfectly explain the cross section of stock returns. Alrabadi & Alrabadi

(2018) state test results could be mainly justified by the fact that ASE is an emerging market in which many unexpected factors apart from fundamentals may interfere in affecting stock returns. However, none of the CAPM, Fama and French three factor model, Fama and French five factor model can fully explain the cross section of stock returns in this market. It seems that its unique characteristics as an emerging market make it difficult to find the best model that can perfectly fit that data in ASE. While the asset pricing models assume perfect markets, emerging markets are not. They are characterized by information asymmetry, inefficiencies, ownership concentration, high volatility, thin trading, higher transaction costs, a smaller number of investors, smaller market capitalizations and higher sample average returns than developed markets (Alrabadi & Alrabadi, 2018). Consequently, the task of finding how stocks are priced becomes harder than doing it in the developed stock exchanges.

Mosoeu (2017) conducted tests in an attempt to evaluate the performance of the five-factor model in explaining returns for diversified portfolios. This study found that the performance of the five-factor model depends on the region upon which it is being tested, especially for emerging markets, although the global five-factor model fails dismally as compared to the emerging market five-factor model. Across all the countries studied, the market premium is redundant, except for India and South Korea, together with some of the other factors depending on the country. For Indonesia, market premium is the only redundant factor responsible for explaining the patterns in average returns for the sample period. The standout being the weakness of market factor as a potential variable in explaining equity returns in the countries examined during the period between January 2010 and November 2016 as per the factor spanning tests in all the countries except for India and South Korea. Across all portfolio sorts and countries, there exist some form of relations between average returns that are related to size, value, profitability, and investment. Though these patterns are not transparent in some of the portfolio sorts, and the level of transparency may vary with countries. Furthermore, among the five factors, overall, low correlations are observed except for China with Size and Profitability. For the regions studied in this research, looking at the overall picture, the average returns of big stocks outweigh those of small stocks. For Profitability, those firms that are robust are generating greater returns than those firms that have weak profitability margin. Aggressive firms are those that purchase a lot of assets, their returns are superior to those that exercise caution for South Africa, China, India, Malaysia, Indonesia, and Singapore. The regression results provide further insight into the performance of the five-factor model. Interpretation of the intercepts provided support for the GRS test results for some of the countries and for different portfolio sorts. Other countries produced insignificant and low values of intercepts despite the five-factor model being rejected in those countries, which is a conundrum. Overally there is no consistent relationship that can be noticed across the countries to conclude the model's performance based on the state of the market, that is, emerging or developed, the results differ substantially. Although the Emerging Market five-factor model proved to be efficient in explaining the returns of portfolios developed using Emerging Market countries.

Ozkan (2018) found that the newly proposed asset pricing models are less explored in developing markets. This study attempted to necessitate the value factor in the model between July 2009 and June 2015 in Istanbul Stock Exchange. The main result is that the Fama and French five factor model is an applicable and valid model in ISE. On the other hand, the factor premiums are not as high as Fama and French (2015) findings. The market return provides the highest premium in the 72-month analysis period whereas firm size premium has almost vanished. It seems like HML is not a redundant factor in explaining common variation in stock returns at least in the analysis period. It is further found that the value factor is not redundant in the Fama-French five factor model.

Dirkx and Peter (2018) test the Fama-French five-factor model for the German market using recent monthly data from 2002 to 2017. In their findings, the results show that in comparison with the three-factor model, the five-factor model does not add significant explanatory power to the analysis. They conclude that the validity of the profitability and investment factors within the context of international asset pricing studies, cannot be transferred to the country-specific case of the German market.

Mosoeu & Kodongo (2019) test the five-factor asset pricing model of Fama & French (2015) on selected developing and two developed equity markets. Their study notes there is a relationship between average returns and firm Size, Value, Profitability, and Investments although these patterns are not uniform across portfolio sorts and the nature of the relationships vary by country. Generally, they find the average returns of stocks on large-size firms appear to exceed those on stocks of small-size firms. Similarly, the average returns on low B/M stocks exceed those of stocks with high B/M ratios. For Profitability, firms with robust profitability performance are generating greater returns than those with weaker profitability. Average returns on stocks of aggressive firms (those with greater asset purchases) are superior to those that invest with caution. These results are largely robust across portfolio formations and countries. Their most important finding is that, unlike in developed markets, is that profitability (RMW) is the single most important factor explaining average equity returns in emerging markets. This finding makes sense in the emerging markets context where accounting measures could be deemed the more reliable indicators of expected performance. Expectedly, diagnostic tests generally reject the five-factor asset-pricing model in the emerging markets. Given their distinct features, such as size, infrequent trading, and weak accounting standards, that set them apart from more developed equity markets it appears that it may be a long while before the search for an appropriate set of factors for pricing emerging markets equities/assets can be identified.

3.3. Summary of Reviewed Literature

a) Similarities

Evidence supporting the use of multi-index models in explaining the return generating process on the JSE is found. The results provide additional support for Van Rensburg (1997)'s hypothesis on market segmentation on the JSE. Van Rensburg and Slaney (1997) investigated the implications of market segmentation on underlying JSE financial industrial and resource stocks for the estimation of security betas using factor analytic procedure for the period 1980 to 1989. The presence of segments is there even in a follow-up study van Rensburg (2002) shows they are observable. Chimanga (2008) provided additional support for the study by Van Rensburg and Slaney showing that a relationship between stock returns and market segmentation is evident using stocks listed on the JSE from 1997-2007. In addition, Bowie and Bradfield (1998) found additional evidence of the apparent market segmentation between mining and industrial sectors of the JSE exposed in the pricing of securities. Vardharaj and Fabozzi (2007) also report on evidence of market segmentation on the presence in South African Equity Markets. Bekaert (1995) and Bekaert, et al. (2011) believe there are higher levels of segmentation in emerging markets. However, in recent studies there has been a noticeable amount of integration has been noted in Southern Africa more commonly in countries with a high level of trade (Piesse & Hearn, 2002).

In the Canadian economy, Jorion & Schwartz (1986) find the CAPM is not a good description of the country’s securities from 1968 through to 1982. The Hungarian market regarded as a converging economy approaching the ranks of developed countries Andor, et al. (1999) concludes that CAPM acceptably describes the country’s capital market. In an emerging economy, i.e. Uganda, Wakyiku (2010) considers the traditional form of CAPM to hold on the USE, but, beta does not offer a good account of the relationship between market risk and returns. However, Bhatt & Chauhan,(2016) using just five companies show that there is a considerable difference between actual returns and CAPM returns, exhibiting contradictions with the basic assumptions of the model leading them to a conclusion that CAPM has no influence on market returns.

Exploring CAPM evidence it can be noted that the size of the market and amiability of information in the market essential. Thus, the more the integrated market is the less validity of the CAPM. In Hungary where there is an underdeveloped stock market there, CAPM moderately holds. Due to a few data points in the Ugandan Stock Exchange, the CAPM holds but it does not give a good relationship between return and diversifiable risk. However, in markets like the UK where information is readily available and the market is developed and integrated with the rest of the world the FF3FM has superior abilities than the CAPM. In the South African Stock Market, there is still much more explorations. According to Ward & Muller (2012), CAPM as a single factor in South Africa is a redundant factor. Reddy & Thomson (2011) using the CAPM over long-term modelling is acceptable in South Africa and over a certain period of time, it is unacceptable.

Furthermore, Van Rensburg (2002) states that CAPM as conventionally specified by South African academics does not hold on the JSE. Van Rensburg (2001) using industrial shares on the JSE from 1983 to 1999 find earnings to price (value), market capitalization and past twelve-month positive returns (momentum). This evidence is in direct contradiction with CAPM showing that the model fails to explain variations on the JSE cross-sectional returns. Ward and Muller (2012) support the findings of (Van Rensburg & Robertson, 2003; Strugnell, et al., 2011) which find evidence of results in contradiction with the CAPM where beta and return have an inverse relationship. They conclude that the use of CAPM as a single parameter is redundant

Ward and Muller (2012) found that value and momentum are significant on the JSE, but there is no evidence of size effect. In an upgrading investigation of the style-based effects on the JSE, Muller, and Ward (2013), from 1985 to 2011 found momentum still to an important style, together with, strong evidence supporting other styles with a combination including return on capital, cash-flow to price, and earnings yield. However, there was no evidence of small size effect in effect shares with a market capitalization greater than 230 underperform the larger capitalization shares in contrast with other studies. Strugnell, et al. (2011) found evidence value and size effect, which are contrary to the former.

Page and Way (1992) follow up on a Muller (1999) study find that the winners and losers show an evident presence of momentum, they also found, evidence of mean reversion. In another study, La Grange and Krige (2015) found that the momentum effect is evident on the ALSI top 40 between 1998 and 2013, while, Bolton and von Boetticher (2015) using data from 2009 to 2014 found that after 2008 financial crisis there is no evidence of momentum effect observed. Moreover, the US market is comparatively more influential in accounting for fluctuations in the ASEAN markets. The US market affects all economies and the 2008 global financial crisis is noteworthy.

Ozkan (2018) found that the value factor is not redundant in the Fama-French five factor model. In addition, Mosoeu & Kodongo (2019) in ttheir study found that the most important discovery is that, unlike in developed markets, profitability (RMW) is the single most important factor explaining average equity returns in emerging markets.

Dirkx and Peter (2018) test the Fama-French five-factor model for the German market and conclude that the validity of the profitability and investment factors within the context of international asset pricing studies, cannot be transferred to the country-specific market. Mosoeu (2017) also found that there is no consistent relationship that can be noticed across the countries to conclude the model's performance based on the state of the market, that is, emerging or developed, the results differ substantially. Mosoeu & Kodongo, (2019) went on to reject the five-factor asset-pricing model in the emerging markets.

b) Differences

Jorion & Schwartz (1986) find evidence of market segmentation as a result of legal barriers. Bekaert (1995) gives an important analysis that investment barriers might lead to segments in the market. Emerging markets in this study show varying levels of integration due to factors that include lack of quality-regulatory accounting framework, economic mismanagement, and political instability. These increase risk premiums to returns which deter some foreign investors. Bekaert believes that CAPM can be a reasonable descriptor for returns but require modification to capture for time-varying degrees of market segmentation. However, in a follow-up study with a newer model-free measure of market segmentation Bekaert, et al. (2011) show that segments shrink as growth opportunities and discount rate increase globally. They believe globalization has reduced market segmentation and encouraged openness. Investor preferences still play an active role in price convergence universally. A noteworthy finding of this study on an industry level in the market is that formerly heavily regulated industries like banking have the highest levels of integration.

The use CAPM is not advised by many researchers' due to lack of evidence to support, but, Nel (2011) support the use of beta and CAPM, and disagree significantly on the use of APT. On the other hand, some researchers, in particular, van Rensburg (2002) argues it is better to use a two factor APT. In the US Fama and French (2014) proved that their five-factor model is an improvement from other models in explaining return. This model makes the value factor redundant. Racicot and Rentz (2016) empirically indicate that it seems quite effective in explaining the returns. However, in the Nordic markets provides evidence of a disappearing size effect and finds that small stocks generally have lower market betas than big stocks.

Jegadeesh & Titman (2002) found that short-term strategies are characterised by many transactions that are driven by short-term price movements because these strategies are built around taking advantage of these short-term price movements. This makes short term momentum an interesting factor in the local stock market. Gustafsson and Lundqvist (2010) find momentum (12-month) to be positive and economically significant in South Africa. Thus, exploring the market using the Carhart four factor model using a six-month holding period over a long period would show how if short-term momentum enhances the study.

Dirkx and Peter (2018) find that in Germany the five-factor model does not add significant explanatory power to the analysis. However, Alrabadi & Alrabadi (2018) in an emerging market in which many unexpected factors apart from fundamentals may interfere in affecting stock returns find that none of the CAPM, Fama, and French three factor model, Fama, and French five factor model can fully explain the cross-section of stock returns in this market.

c) Identified Gaps

The preliminary literature shows that the research methods and objectives of the studies varied across all the investment style-risks and there is still limited research that has concentrated on examining all five factors, market risk, value effect; size effect; momentum effect; profitability effect and investment effect prior and post the 2008 global financial crisis in the South African stock market. Furthermore, there is no consensus on the results presented some have found evidence and some do not find any evidence due to varying study data samples of the validity of the FF5FM. This motivates this study to examine the main sectors of the JSE between 2000 and 2016 (before and after 2008 financial crisis) and make use of the Carhart four-factor model and Fama and French five-factor model to investigate the relationship between the investment style-risks with JSE sectors. Market anomalies are common in equity markets and with growth and time, they become more frequent and persistent or disappear or weaken. Thus, this makes interesting research to examine the effects of market anomalies on returns and how the economic crisis' affects the performance of stock returns. In South Africa, it is evident that talk of anomalies has not been fully exhausted, hence, more research using multi-factor models required so as to give more answers. Research on the Fama and French five-factor model is minimal in emerging markets, especially in Africa. Investigation on all market anomalies and a comparison of the factor models should shed more light on this issue whether the phenomenon exists in South Africa.

d) Conclusion

It is evident there is a vast wealth of empirical literature trying to explain the relationship between risk and return. Some of these empirical studies aimed to establish if market anomalies such as size, value, investment, profitability, and seasonal effects persisted the same way in emerging markets as they did in developed markets. The literature in this study covered evidence from different stock markets, both developed and emerging. Looking at the practical work done and shown by Fama and French it seems it would be in the best interests for investors to use the other factor models until this method proves itself in the empirical evidence. However, it was determined that the single risk factor was not sufficient as it missed many variations that affected stock returns. Due to the shortcomings of the CAPM, asset-pricing models such as the FF3FM, the CH4FM, and the FF5FM were developed but these multifactor asset-pricing models are not without fault. The FF3FM has been criticised for lack of theoretical backing and recently it was established that the factors incorporated in the model missed variations captured by profitability and investment.

The empirical evidence reviewed in this chapter indicated that most of the effects were present both on emerging and developed markets, but the seasonal anomalies differed due to different year ends in each of the countries. Furthermore, there seems to be no empirical consensus on the presence of the market anomalies, as the results tend to differ with the methodology or the selected sample. It is evident that even though there are numerous theories and asset-pricing models, mispricing could lead to irregular patterns in the market, which investors can use to their advantage and obtain abnormal market returns. There has not yet been clear evidence as to what causes the presence of market anomalies, however, it is clear that they differ from markets, sectors of the stock market, economies, model specifications and in some instances asset-pricing models are unable to account for them. Thus, this study examines the effects of investment style risks on expected returns on the JSE using the major asset pricing models. Therefore, the next chapter describes the test method, along with the data used for the research study, in more detail.

CHAPTER FOUR: DATA AND METHODOLOGY

4.1. General Overview

The debate on whether asset pricing models fully explain expected stock returns is one that is far from being concluded. Many models have been developed since the traditional Capital Asset Pricing Model because many researchers, academics and asset manager believe that not all risk factors are captured. There are major differences in empirical results that have been found in developed and developing markets using the same models, hence, the continued debate that the models do not fully explain expected returns. Empirical evidence has driven the development of asset pricing models which began with the Capital Asset Pricing Model (1964; 1965; 1966), Fama and French three-factor model (1993), Carhart factor model (1997) and the most recent the Fama and French five-factor model (2015). This study attempts to apply the asset pricing models and the test their abilities in explaining the expected return on the different Sectors of the JSE.

This chapter mainly focuses on the sample selection and providing comprehensive explanations on the models that were used in the analysis. The chapter commences by explaining the sample selection and description of the data and research setting. A description of the market proxy, market beta, and the risk-free rate is provided. The chapter will then proceed to give a description of how the variable (value, size, momentum, investment, and profitability) were, be calculated. This is followed by a discussion of the asset pricing models factored to examine the effects market anomalies have on JSE sector returns. Hereafter, the potential biases that might affect the data and how they were mitigated.

This study made use of monthly sector indices returns on the JSE Securities Exchange obtained from IRESS for the period January 2000 to December 2016. The study considered all listed companies available on the JSE main board, implying that all listed companies on the mainboard, during the sample period, were considered. However, suspended companies and companies that did not stay on the mainboard for the whole sample period were excluded from the sample. Therefore, the total sample size of the study consists of 163 companies after all the adjustments.

4.2. Data Sources and Research Propositions

4.2.1. Data

Since this study conducted a cross-sector analysis, different sectors of the JSE were selected. The JSE currently has 40 Sector indices which include constituents of the All-Share Index. They make use of the main sectors namely resources, industrial, financial, basic material, consumer goods, consumer services, general retailers, technology, telecommunications, travel & leisure, health, and food & drug retailers. The study's cross-sectional analysis considered only the ALL Share Index against the resources, industrials, and financials. The sectors were, telecommunications, technology, healthcare, basic material, consumer goods, consumer services, general retailers, travel & leisure, and food & drug retailers have some small number of companies in each sector, thus, was not used for the sector cross-sectional analysis. Furthermore, the utility sector was omitted, as there were no companies listed in this particular sector during the whole sample period. Thus, a total number of 163 companies were analysed across the major sectors.

The basic resource sector comprises of companies that trade chemicals, all types of mining, industrial metals, forestry, and paper. The industrial sector consists of companies in the line of work that encompasses construction and building materials, support services, industrial engineering, and industrial transportation. The financial sector consists of companies dealing with basic non-life insurance, life insurance, real estate investment, real estate investment trusts, financial services, and equity investment instruments.

The data set contains firm characteristics consisting of monthly and annual share prices, trade volume data, firm-specific attributes and accounting variables listed and defined in Table 4.1 below. Portfolios sorts are conducted using financial statement data from IRESS where value is proxied by book-to-market ratio and a price-earnings ratio, size, by market capitalization operating profit, total assets, value, outstanding shares, total liabilities, valuation ratios and momentum excess returns earned over previous 6-month intervals. Thus, monthly share prices and trading volumes are essential in the segmentation analysis. The timeline was chosen to examine if the style-anomalies influence returns the same relationship before and after the 2008 financial crisis and the restructuring of the JSE. Abrogating the need to calculate these returns using the monthly price changes and dividends paid total returns collected for all securities in the sample.

Security prices appear to differ from their intrinsic values prior, during and post a market crash. Bubbles are difficult to predict and exploit, but, their effects are real. Moreover, the effects of new information being quickly assimilated into prices have separate effects between a bull and bear market. The effects of the information change the demand from investors. Thus, spiked the interest of exploring in-depth how investor arbitrage before and after the 2008 global financial crisis. This will explore from the market anomalies view because they are linked to investment strategies that investors would employ. Some strategies might be too expensive, and some might be profitable, hence, it worth exploring in the South African context over a period where a bubble affected the security prices.

The sample study spans from 01 January 2000 to 31 December 2016 a total of 240 months. This period was chosen to evaluate performance after apartheid in South Africa and 20 years into democracy. This is after sanctions on South Africa had been lifted and its markets opened to trade with the rest of the world. In addition, this was the period of growth in information technologies which influenced part of the restructuring which took place on the JSE. This period growth in globalisation which improved the impact of computer systems and internet access which improved access to the equity market. Considerable power was placed in the hands of individuals, both prospective and existing investors. This had a profound effect on how investors obtain information. Equally important this has lowered costs, increased speed, fast transaction execution times, data availability and price transparency significantly.

Moreover, this period examination period covers the two most historic global crushes that spilled into South Africa, i.e., Information Technology bubble crash that occurred in 2000 and the other is the sub-prime market crash of 2008. However, this was short-lived as markets picked up again in 2009, indicating a bull. Regrettably, in 2010 the market experienced another downturn due to the Eurozone's debt crisis, therefore constituting a bear-run, which is still ongoing due to low levels of economic growth, increasing government debt and increasing unemployment. In addition, one of BRICS trading partners, China is experiencing an equity bubble, which started in early 2015. In the same period, the Chinese started flooding the market with products such as steel which affected South African exports. The choice of examination period has a distinct advantage that the outcomes of the tests conducted in this research are based on two distinct economic phases. Furthermore, relationships are more easily identifiable through economic cycles. Thus, these had an impact on the performance of securities and investments decisions. The periods 2000 and 2008 were marked by excessive speculation which led to extreme growth in the usage and adaptation of internet by consumers and businesses., When investors saw the damage to the financial markets by loan defaults, the began to disinvest worsening the situation and creating a full-blown global financial crisis. Thus, it is essential to examine security performance and style anomalies which exist during periods of the normal business cycle, global crises and thereafter the recession.

4.2.2. Accounting Variables

As with any empirical test for market anomalies using an asset pricing model one need variables from both internal company's financial statements and external firm's performance on the security exchange. The regression equation includes the accounting and financial ratio variables that are used to estimate the style-based factors. These include the following:

Table 4. 1: Accounting Variables used in the analysis

VARIABLE	***DEFINITION***
Share Price	The price of an individual share price of a company
Trading Volumes	The number of shares transacted every day
Market value per share	The current trading price for one share in a company
Number of Outstanding Shares	A company's stock currently held by all its shareholders, including share blocks held by institutional investors
Total Return	Total amount an investment earns over a specific period of time.
Market Value	Referred to as Market Capitalization is defined as the value of a company’s outstanding shares.
Book Value	Total assets minus intangible assets and liabilities.
Book-Value per share	The ratio of the per-share value of a firm based on Common Stock Equity
Price-earnings ratio (P/E)	Market value per share / Earnings Per Share
Dividend per Share (DPS)	The rand value of the annual dividend by the current share price.
Earnings per Share (EPS)	The difference between net income and dividend paid divided by outstanding shares
Operating Profit	This is the profit earned from business operations (gross profit minus operating expenses) before deduction of interest and taxes.
Total Assets	This represents anything that a business owns (fixed or current) which has an economic value
Total Liabilities	This is the total financial obligations and debt owed by the company
Total Shareholders’ Equity	This represents the equity stake currently held on the books by a company's equity investors (equal to Total Assets-Total Liabilities)
Risk-free Rate	Government bonds or debt securities with maturity of less than a year, thus, SA 3-month Treasury Yield (per month)
Momentum	Stock’s return over a 12-month period despite an upward or downward direction of the share price.

Source: Compiled by the author

4.2.3. Research Setting

This is a quantitative research that makes use of secondary data. The data is collected from IRESS (used to be INET) and the South African Reserve Bank. IRESS is a financial services provider that specializes in financial data retained in the Southern African Markets. Their core business is providing economic and financial market data and corporate market intelligence. Additionally, the SARB provides information on treasury bills which are short-term debt obligation of the South African government, commonly termed, risk-free. Thus, for this study, the South African Reserve Bank Treasury bills - 91 day (tender rates) were used. IRESS. and SARB were chosen for this study because that offered historic data essential for this examination. The data used from IRESS similarly to Muller & Ward (2013) was obtained from two sources. The JSE was accessed for share information and company financial information was obtained.

4.2.4. Choosing Market Portfolio

Theoretically, the market portfolio is a bundle on investment which includes all securities, financial and other assets available in the financial market with the weight of each asset-weighted in proportion to its total presence on the market. Thus, it represents the total market value in this case of all stocks that an investor would own if she or he bought the total of all marketable stocks on the stock exchange. A proxy for the South African Market needed to be selected. In an empirical test, a proxy measure must be used for the market portfolio because it will be difficult to neither accept nor reject the CAPM without a market portfolio that can be identified exactly (Roll, 1977). The market portfolio is central to the estimation of expected returns and testing of the asset pricing models. Thus, there must be careful selection of the market proxy because the wrong choice can result in reduced predictive abilities of the CAPM (Roll, 1977; Bowie & Bradfield, 1998). Therefore, this study the FTSE/JSE All-Share Index (FTSE/JSE ALSI) was used as the market proxy. This is denoted the code M for this index in formulas below. The classification of the All Share Index include all constituents of the Industry Classification Benchmark (ICB) is Sectors.

Preferably, asset pricing tests ought to be conducted on individual securities but considering there are over 170 actively trading securities on the JSE, statistical considerations force grouping of stocks into portfolios (Cochrane, 2001). Running asset pricing test on portfolios significantly reduces the impact of firm-specific risk on estimation on means and other descriptive statistics. Thus, grouping allows for the decrease in the number of test assets and minimizes loss of information. This led to the study being based on sectors and the three most prominent, resources, industrial and financial sectors were chosen. These three moves in tandem with the ALSI and the measure of their risk (i.e. volatility on return) is examined. The preferable method of factor construction for this study was to take into account the segmentation of the JSE into resources, financial as well as industrial shares.

4.2.5. Risk-Free Rate Index

Risk-free Rate of return is the theoretical rate of return attributed to an investment with zero risk over a specified period of time. The risk-free rate has no default risk and no correlation with other investment. The interest rate on a 3-month treasury bill is used in most cases as the risk-free rate. Short-term government-issued securities have close to zero default risk; hence, they are used as the Rf proxy. Academic empirical work uses short-term risk-free rate, while, practitioners' favour long-term rate because it is consistent with the goal of estimating long-run equity costs and the short-term rate is seen as too volatile according to Correia & Uliana (2004). This study will make use of longer-term government bills which will match the duration of the cash flows of the securities being valued. The risk-free rate for the period was taken from the South African Reserve Bank Treasury bill, i.e. 91-day (tender rates).

4.2.6. Market Risk (Beta)

Beta is related to the volatility of the expected outcomes caused by macroeconomic factors such as political events and socio-economic events that have an effect on the returns of assets. An example is inflation surges which affect companies differently, but, have an effect in some way. The beta of the market is defined as 1.0 and is calculated as follows:

$$\text{Beta } (\beta) = \frac{Covariance(R_m, R_j)}{Variance_m} \quad \{4.1\}$$

Where;

Rm: refers to the expected return from the market

Rj: refers to the expected return from a given investment

4.3. Model Specification

This section encompasses all models and regressions estimated for the study to test the effects of market segmentation and the effects of different anomalies in the South African stock market. These numerous asset pricing models that have been tested to estimate expected stock returns, including, those models, suggested in determining the effects of market anomalies in the financial markets. The CAPM, FF3FM, CH4FM, and FF5FM are compared to see which model performs better. The study examines estimated returns for each individual company, the size, value, momentum, investment and profitability variables on the major indices of the JSE. This study follows a quantitative research design where the focus is to show the impact of market segmentation, the behaviour of CAPM returns and evidence of market anomalies on JSE sector returns. The Model for each objective is explained below.

4.3.1. Objective One: Predictive Ability of the CAPM

In order to predict returns of the sample returns, returns were regressed against the returns on the market proxy (All Share Index) using the time series regression for each share using the Capital Asset Pricing Model. (Sharpe, 1964, Lintner, 1965, Mossin, 1966). This model uses market risk known as market beta as a single risk factor. In the past empirical tests on the CAPM have been a success, but, researchers have found problems and criticized the model for using a single risk factor, which does not sufficiently capture all information about the estimated return. CAPM predicted returns are expressed using the following formula

$Ri= Rf+\beta\_i (Rm- Rf)$ ……………………………………………………………………………..{4.2}

Where;

Ri: refers to the return on asset i

Rf: refers to the risk-free rate

β: refers to the Beta of the assets

Rm: refers to the return of the market portfolio

(Rm – Rf): refers to the Market Risk Premium (MRP)

Reddy and Thomson (2011) find that in their study CAPM could be rejected for certain periods. CAPM cannot be rejected, thus, there is a need for more evidence to support the use of CAPM as a decision-making tool. They propose the use of CAPM on long-term actuarial modelling can be reasonably justified in the South African market. However, Ward & Muller (2012) suggest that the use of single factor CAPM with beta only is inappropriate. CAPM fails the empirical tests because the single index and explain returns on too many securities. Several authors on the JSE have noted significant inadequacies relating to CAPM. Van Rensburg & Slaney (1997) back the use of the two-factor APT model. Thus, this study was to test the predictive abilities the CAPM together with multifactor asset pricing models over the 20year examination period.

4.3.2. Objective Two: Comparison of the Multifactor Asset Pricing Models

In determining the effects of market anomalies on expected return FF3FM, CH4FM and FF5FM were employed. These models will enable comparison to be performed on which model best explains expected return and captures major risk factors.

i. Fama and French Three Factor Model

Fama and French (1992, 1993) argue that CAPM, as a test of the EMH should be adjusted to account for additional risk factors namely, the size effect and value effect. In Addition, FF3-factor model is an amended version of the CAPM, which is able to clarify the size and value risk premia in the model. The model's foundation is the three explanatory variables (Rm - Rf), SMB and HML, these three variables are how the three-factor model is supposed to explain stock returns better than CAPM. Because together they explain the non-diversified risk in stocks better than the CAPM according to Eugene Fama and Kenneth French. To capture cross-sectional expected returns on the South African stock market associated with size and value characteristics, (Fama & French, 1993) proposes a three-factor model showed in its regression form:

$R\_I = R\_f + \beta(i)\ (Rm - R\_f) + \beta\_SMB * SMB\ +\ \beta\_HML * HML$ ……..……………….... {4.3}

Where;
Ri: refers to the return on asset i
Rf: refers to the risk-free rate
β: refers to the Beta of the assets
Rm: Return of the market portfolio
HML: refers to the return spread of small minus large securities (i.e. proxy for value).
SMB: refers to the return spread of small minus big market capitalization (i.e. firm size).

Basiewicz and Auret (2010) recommend that the three-factor model could be used in estimating expected returns for firms listed on the JSE. They performed a time series test and found an evidence value effect and size effect, but, noticeable differences were the mispricing of different assets and the direction of the mispricing.

ii. Carhart Four Factor Model

Motivated by the evidence provided by Jegadeesh and Titman (1993) on the existence of significant medium-term price momentum trends, Carhart (1997) four-factor model improves on Fama-French Three Factor Model by adding one additional factor; momentum. This factor was added, because many studies, like Jegadeesh and Titman (1993), Fama and French (1996) and again Jegadeesh and Titman (2001) found that it was possible to increase your earnings by buying stock that was doing well over the last 1-6 months and selling stocks that were doing badly over the last 1-6 months. Carhart (1997) identifies that the FF3FM does not take into account momentum investment strategies which influence asset returns. Carhart's momentum factor really opened the discussion on the so-called "factor wars." The momentum anomaly can be referred to as a market inefficiency due to slow reaction to information (Chan et al., 1996). Several studies have confirmed and extended the work of Jegadeesh and Titman (1993), and numerous explanations have accounted for momentum profits. To explore the influences of investment style-risks the Carhart four-factor model is employed because it includes momentum which is a very important factor in evaluating performance. The independent variables employed by Carhart (1997) model include investment style risks namely; *the value risk premium (HML), the size risk premium (SMB)* and *the momentum risk premium (WML).*
The four-factor model of Carhart (1997) is employed in regressions to estimate a payoff to each attribute monthly is shown in the following Equation 2:

$R_i - R_f = \alpha_i + \beta_i(R_m - R_f) + \beta_{SMB} * SMB + \beta_{HML} * HML + \beta_{MOM} * WML$………………{4.4}
Where;
αi: refers to Jensen's Alpha
WML: refers to the return spread of winners minus loser's stock (i.e. Momentum risk factor)

iii. Fama and French Five Factor Model

The Fama and French three-factor model (1993) was a great improvement from the CAPM, however, it did not explain some of the anomalies essential in explaining the variations in expected returns with emphasis on the profitability and investment effects. The CH4FM is currently the conventional performance benchmark currently employed. Thus, Fama and French recently augmented that there were missing factors. Thus, a five-factor model capturing size and value with additional factors profitability and investment in estimating patterns in security returns showing better performance than the three-factor model was formulated (Fama & French, 2015). Predictions for the model are developed from the dividend discount valuation model that indicates that profitability and investment are related to average returns (Fama & French, Profitability, investment and average returns, 2006). Some existing papers look for book-to-market, profitability, or investment effects on average returns and treat them as isolated anomalies. The aim of these authors was to provide an overall perspective on how the combined anomalies explain the cross section of average stock returns.

Adding profitability and investment factors, the five-factor model regression has the following equation:

$$R_I - R_f = \alpha_i + \beta_I(R_m - R_f) + \beta_{SMB} * SMB + \beta_{HML} * HML + \beta_{RMW} * RMW + \beta_{CMA} * CMA + e \qquad \{4.5\}$$

Where:

RMW: refers to the return of the most profitable firms minus the least profitable (i.e. profitability factor)

CMA: refers to the return spread of firms that invest conservatively minus aggressively (i.e. investment factor)

iv. Justification of Methodology selection

The purpose of using the Fama MacBeth (1973) regressions on the selected models is to test which model best captures average return on the JSE securities. The regressions will identify whether the variables are negatively or positively correlated to each other, thus, further identifying how all the factors are related to affect average returns of stock returns.

These models have to be compared together especially the five-factor model to prove if it is an improvement to the other models and check whether there is room for improvement for the model to be further developed in future research within the South African economy. It takes years for a model to be accepted by stakeholders and in this case, there is lack of evidence in this economy. Will the five-factor model be able to account for expected returns on the JSE? In the Chinese market (Jiao & Lilti, 2017) the model does not have a significant improvement in explaining average returns compared to the US market. The model specifications play an important role in the asset pricing models and it is essential to ascertain which models applicable to the South African market.

4.4. Variable Description

This section gives a description of the variables from the Fama and French models and the Carhart model. The FF3FM give value and size, while, the CH4FM gives momentum signal and the FF5FM give the two additional profitability and investment variables. The variables are summarised below with descriptions of how they were derived in this study.

4.4.1. Stock Returns

These can be viewed as the returns that investors generate out of the stock market. This can be negative or positive return over a particular period, but not fixed. Thus, in this study return was derived as

$$Stock\ Returns = \frac{(Price_t - Price_{t-1}) + Dividend_t}{Price_{t-1}} \qquad \{4.6\}$$

Price $_t$:	Ending Stock Price
Price $_{t-1}$:	Initial Stock Price
Dividend $_t$:	Ending Dividends

This is one of the most essential measures of investors' success because it shows the rate at which their funds have grown during the period (Bodie, Kane, & Marcus, 2012).

4.4.2. Size factor

Size is defined as the situation where small firm stocks earn higher expected returns than larger firm do. Thus, bigger firms have small returns. This is characterized by a firm's market capitalization, which has been proven to be the most appropriate measure of size. The market value of a firm's outstanding shares in issue is taken directly from the underlying FTSE/JSE index data and multiplied by the index-recorded share price.
Thus, calculated as

(SMB) Small Cap−Large Cap (JSE Top 40) ……………………………………………………{4.7}

4.4.3. Value factor

Value is defined as stocks that have a high book-value to price; high dividend pay-out and/or low price-to-earnings ratios. Accordingly, growth stocks are stocks with a low book-value-to price ratio and usually, they do not pay out dividends. Therefore, the value effect is the superior performance of stocks with a low price-to-book ratio compared to those with a high price to book. However, there are several ways to measure this variable, like the use of the book value to market value, price to earnings ratio or the dividend yield. On the JSE value measures can be considered as book to price, sales to price, dividend yield and cash flow to price. To ensure data availability at all time book values are lagged 6 months, and the most recent market values are used to compute the ratios as depicted below.

$$Value\ Signal = \frac{Book\ Value\ of\ Equity}{Market\ Value\ of\ Equity} \quad \text{……………………………………………} \{4.8\}$$

For this study HML was be calculated as Value – Growth.

This ratio is computed by taking the most recent book value six months prior to the current month and dividing it by the market value as at the end of the previous month.

4.4.4. Momentum factor

Momentum can be defined as the past prices' movements. Thus, Momentum is defined as the prior three to twelve-month total stock return, less the prior month's return to account for any short-term reversal effects. Therefore, momentum effect is stocks that have been performing well during the past three to twelve and continue to do well over the next month and stocks that have done badly continue to do so., Investors, would tend to sell stocks not performing well and buy be best-performing stocks based on the return on previous periods.

$$Momentum_M = \frac{Total\ Return_t - Total\ Return_{t-M}}{Total\ return_{t-M}} \quad \text{……………………………………} \{4.9\}$$

M: Three or Six months prior

4.4.5. Profitability factor

According to Novy-Marx (2013) profitability has the same power as value strategies and can be defined as the ratio of operating profit (total annual revenue, net of sales and other expenses) to the most recent book value for the previous year. Profitable companies have bigger market returns than unprofitable firms. They show there is a robust and strong return premium in holding profitable stocks. Fama and French (2015) measure operating profitability as revenues minus cost of goods sold, minus selling, general, and administrative expenses minus interest expense all divided by book equity for the fiscal year ending in the calendar year. Novy-Marx (2013) measure annual book equity as in Davis, Fama, and French (2000) as stockholders' book equity, plus balance sheet deferred taxes and investment tax credit, minus the book value of preferred stock. Hou, et al. (2014) measure profitability by using return on equity (ROE). This ratio measures a firm's profitability by unveiling how much profit a firm generates with the shareholder's money invested in the firm. In their study, they used operating profit then divided it by one-quarter-lagged-book equity.

Thus:

$$Profitability = \frac{Net\ Income\ before\ Interest\ and\ Tax_t}{ROE_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \{4.10\}$$

ROE_t = Return on Equity

4.4.6. Investment factor

The real investment factor," which is the same YoY asset growth scaled by lagged total assets. Investment is defined as the relative growth in total assets six months prior to the current month. Fama and French (2015); Hou, Xue, & Zhang,(2014) measure the investment factor as the change in total assets from the fiscal year ending in year t − 1 to the fiscal year ending in t, divided by total assets from the fiscal year ending in t – 1. Therefore, this study uses the same method for estimation investment variable. This variable estimation is calculated as follows:

$$Investment = \frac{TA_t - TA_{t-1}}{TA_{t-1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\{4.11\}$$

TA: Total Assets

Table 4. 2: Summary of the variables

Variable	**Calculation**	**Formula**
SMB (Size or small firm effect Risk Premium)	Small minus large cap	Small Market Cap −Large Market Cap (JSE Top 40)
HML (Value Risk Premium)	Value minus Growth (t-6)	$Value$ (thus, high book-to-market) $-Growth$ (thus, low book-to-market)
WML (Momentum-Risk Premium)	Winner prior 6-month returns minus loser prior 6-month returns	$\frac{Total\ Return_t - Total\ Return_{t-6M}}{Total\ return_{t-6M}}$
RMW (Profitability Factor)	Robust Minus Weak operating profitability	$\frac{Net\ Income\ before\ Interest\ and\ Tax_t}{ROE_t}$
CMA (Investment Factor)	Conservative Minus Aggressive investing	$\frac{Total\ Assets_t - Total\ Assets_{t-1}}{Total\ Assets_{t-1}}$

Source: Compiled by the author

4.5. Estimation Techniques

4.5.1. Stationarity

Stationarity is the method of the statistical parameters where the mean and standard deviation is constant over the period. Gujarati (2004) argues that the values of covariance amongst the two periods depend on the gap between times but not the present period in which the covariance was computed. Auto-correlation function (ACF) is the essential property of stationarity that depends on its lag, which does not change at the time, was calculated. Brooks, 2008, is of the view that dependent and independent variable finite variance, the errors must have zero mean and be stationary. If a set of variables are both non-stationary, it's mean and time-varying mean or variance must integrate of order (0) and be the difference once to become stationary. The danger of running non-stationary data is that there will be a spurious regression problem or misleading results. If variables are still non-stationary after integrated order (1) even not stationary, it will need to be difference twice that is integrated order (2) up until become stationary.

The reasons for data to be tested for unit root are as follows, firstly series can intensely impact its behaviour and properties, and secondly, it can lead to spurious regression problem, which means that in the long run variables in a period are trending. Another shortcoming of non-stationary variables is that even independent variables turn to have higher R-Squared. The usual t-ratio, t-distribution, and F-statistics will be challenging to validate through hypothesis test and regression parameters (Brooks, 2008).

4.5.2. Augmented Dickey-Fuller (ADF) Test

Gujarati, 2004 states that the order of integration can be only tested using the Dickey-Fuller test. The Augmented Dickey-Fuller (ADF) and Dickey-Fuller (DF) both are the best often used to test the unit root tests of the time series. ADF theory aimed to test the hypothesis that $\emptyset=1$ in

$$Y_t=\emptyset (y_{t-1}) + \mu_t \quad \ldots\ldots\{4.12\}$$

Thus, the assumption is expressed as follows:
H_0: Variables has a unit root
H_1: Variables is stationary

Accepting alternative hypothesis will confirm that the variable means are stationary or does not have any unit root test. Estimates of the standard ADF.

$$Y_t = \beta_1+\beta_2 \Delta Y(\varepsilon_{t-1}) + \mu_t \quad \ldots\ldots\{4.13\}$$

μ_t is an error term of the data sets, Δ is the error term also a linear trend and first difference operator. The normality assumptions should be satisfied by error term, though. Gujarati, 2004 also emphasises that in the equation above if the error term is not separated the results on ADF will be biased. The Dickey-Fuller test is valid only if (μ_t) is presumed to be autocorrelated, (Δy_t) that is explanatory variable if the autocorrelation regression is not correlated. It would be so if there is autocorrelation in the regression of the dependent variable (Δy_t). Thus, the nominal size of the actual test will be oversized. The explanation of this gap is to use the ADF. The substitute model in the ADF case can be presented as follows:

$$\Delta y_t=\beta_1+\beta_2 t+ \delta y_{t-1}+\sum_{i=1}^{m} \alpha_1 \Delta y_{t-1}+u_t \quad \ldots\ldots\{4.14\}$$

Where there is a pure white noise error term and where $\Delta Y(t-1) = (Y(t-1) - Y(t-2))$, $Y(t-2) = (Y(t-2) - Y(t-3))$, etc. Gujarati (2004) argues that the idea to include many error term in equation 4.5 was to ensure that the series is uncorrelated and the number of lagged are determined empirically. The same critical values in ADF to test whether $\delta=0$ follows the same asymptotic distribution as DF statistics.

The calculated ADF values are then matched with the critical values; if the significant value is less than the estimated value, we reject the null hypothesis that variable is stationary, thus approving that the variables are stationary. Gujarati (2004), argues that the critical assumptions for the ADF test are that the error term (u_t) must be (iid), i.e. are independently and identically distributed. The error terms (μ_t) a possible serial correlation is adjusted by DF to take into consideration by adding the lagged difference terms in the regression.

The ADF test has its shortcomings like any other unit root tests. Gujarati (2002) states that utmost as with any other unit root tests has its weaknesses of low power. The power is subjected to the size of the sample data more than its frequency. This may lead to finding unit root where it does not exist. ADF is also weak to detect a false null hypothesis on its ability. Clemente et al. (1990) argue that another weakness of ADF is that, it does not take into consideration of the error term (μ_t) for possible autocorrelation. Also, a well-known shortcoming of DF style is integrated order (1) of the stationary test; it confuses the structural breaks in the data as the signal of stationarity.

The Augment Dickey-Fuller Test was preferred over Dickey-Fuller test based on the weakness mentioned above, for the fact that it does not take into consideration of autocorrelation of the error term and the estimated coefficients from OLS will be not efficient. (Blungmart, 2000)

Brooks (2008) argues that the most significant criticism of the unit root tests is that, their influence is small if the method of non-stationary, which is a root near to the stationary margin. For, instance, an Autoregression model (1), data creating means coefficient 0.95 in the data validation procedure, that is Yt= 0.95 Y(t-1)-1+µt   the Ho: of non-stationary should be not be accepted. It always an argument that these tests are inadequate in determining, for instance, whether, especially with small sample sizes.

Brooks (2008) further argues that this problem emanates from the classical hypothesis testing framework. Ho is undoubtedly be rejected, this means that accepting the null hypothesis is because of not enough information in the sample size to not to accept or null hypothesis was correct.

4.5.3. Cointegration test

According to Brooks, (2008) if two data sets are combined of order I (1) are linearly joint, therefore means, the combination will also be incorporated into the order I (1). To be specific, if data sets are not in the same order of integration are combined, the combination turns to follow the most extensive data sets. The reason to conduct a cointegration test is to find out if the variables move in the same direction or not in the long run. If the variables are found to be cointegrated, the Vector Error Correction Model (VECM) will be used instead of a Vector Autoregression Model (VAR) Gujarati (2004).

The equilibrium relationship exists if the series seems to be moving together over some time. The series, therefore, shows that although the data sets have unit root in the short run if cointegration exists, they will be moving in the same direction over the period and their variance will not have a unit root.

The Vector Autoregressive model (VAR) is a broad context that is used to define stationary variables and their interrelated dynamic. Brooks (2008) argues that if the time series has a unit root; therefore, the VAR context needs to be adjusted to permit reliable estimates of the relations between the data sets. VECM in the case of the VAR for variables that has unit root and become stationary after first difference, for example, I (1). The VECM will take into consideration if any variables are found to be cointegrated amongst other variables. The procedure of VECM can attest that it is a requirement to conduct a cointegration test. A VECM is on purpose to be used on unit root data sets that have a long-run association. Brooks, 2008 strongly believe that VECM has a cointegration that is relative to be constructed to be designed to prevent the long run association of the endogenous variables to come together to their cointegration relations while permitting the adjustments of short-run dynamics. Brooks (2008) furthermore argues that the correction term from the long run equilibrium deviation is steadily corrected from the estimated changes over the series of the limited short run. Consequently, the existence of a cointegration relations procedure as a centre of the VECM condition.

There are numerous methods of analysis of cointegration such as the Engle-Granger methodology which is residual based and the Johansen and Julius (1990) procedure, which are built on extreme possibility estimate on a VAR method. According to Engle-Granger (1987) and Brooks (2008), proposed a procedure of four-step that defines if any two I (1) variables are associated with order I (1) and the method are as follows; the first one is the analysis to test each variable separately to decide its order of integration, secondly to estimate the long-run symmetry association, thirdly the estimation of ECM. The ECM can be used to determine the equilibrium regression; then the fourth step is to assess' model sufficiency.

The Engle-Granger methodology has some shortcomings, and they are as follows, the coincident bias of equation, the impracticality of execution assumption is that the real cointegration relationship and lack of power in unit root test (Brooks, 2008). The rationality behind this method is that it relates to the determined probability estimate to a VECM to concurrently define the short-run and long-run determining the factor of the explanatory variable in a model. This method also makes available of the speed of adjustment coefficient that looks at the rate in which resources, industrials, and financial sector returns to its equilibrium, subsequent, to shock in the short-term into the economy.

4.5.4. Johnson Method Built on VAR

The Johansen and Julius method (1990) is the method that the Vector Autoregression method is built on its maximum likelihood estimates. This method is to test long-run equilibrium relations that allow the given sets of data of all cointegration vectors to be identified. According to Gujarati (2004), the procedure to conduct Johansen tests are as follows:

Test order integration

Specifying the VAR (k) order

Test for cointegration

Normalisation

Test of hypothesis

Testing the order of integration of the variables in the analysis is a requirement. The first condition for the cointegration test is that data sets should be cointegrated in the same order before the test to be conducted. Vector autoregressive (VAR) model representation of order k, the following specification is as follows.

$y_t=\prod 1\ Y_{(t-1)}+\prod 2\ Y_{(t-2)}+\prod k\ Y_{(t-k)}+u_t$ ……..{4.15}

Where;

Kt is a D-vector of deterministic variables and is a vector of innovations yt is a -vector of unit root I(1) variable. To conduct the Johansen test, the equation above is for VAR model that needs to be transformed to VECM only if the one or more variables turn to cointegrated in the long run. This can be written as following VECM equation (4.7)

$\Delta y_t=\mu+\pi_k Y_{(t-k)}+\sum_{(i=0)}^q \Gamma_i \Delta Y_{(t=i)}+\mu_t$ ……………..{4.16}

Where;

q=k-1, ΔYt is all I (0), Γ is n x n coefficient matrices that symbolise the coefficients short-run. π is the matrix, r represents the number of cointegrated equation amongst the variables. The Johansen test is established on the analysis of the π matrices. Then, if r is equal to zero, therefore, means that there is no cointegration equation in the system. Gujarati, 2004) argues that if for example, π has decreased the rank ($r \leq (n-1)$), this implies that the above equation can be stated as the following equation.

$\Pi = \alpha\beta$……………………………………...{4.17}
Where;

α= (n x r) matrices of the speed of adjustment or error correction of parameters and β = is the long-run coefficients. Estimated β are initiates by resolving the eigenvalue challenges so that the eigenvectors equivalent to the biggest eigen values form the estimated β matrix. The size of the eigenvalues shows a measure of how high the correlation between the cointegration and unit root part of the model is. The following steps to first find how various cointegration vectors that find to respectively to its relations. The two test statistics are applied, the λ max statistic and the λ trace statistic. The λ max statistic is of the form:

$\lambda max\ (r+1) = -TIn(\lambda_{(r+1)})$ …………………………...{4.18}
and
$\lambda trace\ (r) = -T\sum_{(i=r+1)}^g (In(1-\lambda_i)$ …………………..{4.19}
Where;

R represents the number of cointegration equation in the Ho, and λi is the value estimated in the i^th order of eigenvalue in the matrix. Automatically, the greater the value of λi, the bigger the negative will be in the (1 - λi), and therefore, the higher the test statistics will be. Eigenvectors will be connected with different cointegration vector. A meaningfully real value of eigenvalue shows a major cointegration vector.

λmax conduct a distinct test on individual eigenvalue that has its null hypothesis equals to several cointegration vectors that is r with the alternative hypothesis of r + 1.

λtrace is a combined test where the null hypothesis with several cointegration vectors that is <=r against the alternative hypothesis of more than r. It first starts with probability eigenvalues; after that continuously, the highest values are distant.

Null Hypothesis =λtrace = 0

when other alternative Hypothesis λk= 0, for k = 1 . . .. g.

Johansen (1990) creates the t-statistics and critical values for the two statistics automatically. The significant of the statistical significance is substantial and non-standard. Values depend on the importance of g-r; the number of unit roots components depends on the value of g-r, and the constants are included in the equations. Deterministic trend and intercepts can also be added in the VAR or the cointegration vectors.

If the critical values for the Johansen test is less than t-statistics significant values from Johansen's tables, then the null hypothesis can be rejected and there are r cointegration vectors in the equation where r represents the number of cointegrated equation, alternatively, (r+1) for λ_trace test or more than r λ_max, Osterwald-Lenum (1992).

4.6. Potential Biases

The potential biases that might influence the results this research include survivorship bias, time-period bias, and look-ahead bias. Disqualified shares will be excluded from the research samples to avoid any biases: based on:

Survivorship bias occurs when financial databases tend to exclude information of companies that are no longer in existence. Firms failing, delisting and becoming inactive will result in them being systematically be omitted from the database at the time of data collection. This can overstate certain conclusions and distort the results in the examination. To mitigate survivorship bias in this study the database will include delisted companies during the examination and only exempt them as of the date of suspension. Thus, the research database includes all firms, including those that have become inactive over the entire sample period. To further reduce the impact when examining segmentation, the examination period is divided into sub-periods and each sub-period will consist of 204 months (01 January 2000 – 31 December 2008 and 01 January 2009 – 31 December 2016).

Time-period bias may make the results of the examination period (2000, 2002, 2008, 2009 and 2016) look time period specific. Certain anomalous behaviours can be persistent for a period of several quarters. Hence, this is mitigated by the research encompassing 17 years with different business cycles in order to ensure that conclusions are not specific to one unique period or cycle. More importantly the study includes the 2002 IT Bubble which was included by Van Ransburg (2002) in the market segmentation analysis and the 2008 global financial crisis which affected all economies.

Look-ahead bias is generated by making use of data in a study that would not have been known or available during the examination period. This causes inaccurate results. The main difference is because of the different dates in which final yearend financial statement are reported and the dates in which predictions are made Adding on, in South Africa, the audited financial results are only released weeks after the official final year-end results. The impact of look-ahead bias is expected to be minimal, though the study will make use of accounting variables the database reports share prices without denying delays which also reduced the impact of look-ahead bias.

Data Spooping occurs when inferences are drawn as a result of prying into empirical results of other researchers to guide the analysis of my own study. Thus, data snooping ascends the minute researchers study the properties of a database or review the results of the database and build predictive models which offer favourable results and test to those models on the same database. The best way to mitigate data snooping is to investigate new data, it might be challenging because the analysis is based on historical data. In addition, the bias can be addressed if data from new markets or different time periods are employed. Thus, this is mitigated by including two major economic cycles in the sample 01 January 2000 to 31 December 2016. The period between 2003 and 2008 is characterised by bull market conditions whereas the period from 2008 to 2013 is characterised by bear market conditions. This will also be used in testing validity of the asset pricing model in both market conditions.

4.6.1. Other considerations

Firstly, preference shares will be excluded from the sample because they are not purely equity Secondly, to correct the slight thin trading conditions on the JSE shares not traded on the JSE for more than 12 months out of the 204 months in the testing period will be excluded. Lastly, in the case of outliers, that is, values which lie outside the majority of the other values meaning they are extremely large or extremely small. These outliers can distort, overweigh or overstate results. This will be mitigated by winsorization. Any values which will fall less than 5th percentile and beyond 95th percentile which will replace the smallest and largest values within the data set, the values will be replaced by average respective boundary values, however, representative of the trend pattern retained.

4.7. Chapter Summary

This study aims to analyse the presence of market segmentation and the effects market anomalies have on stock returns on the JSE. Thus, it took a quantitative approach. This chapter explained where and how the data was collected, it further described the sectors examined and how the variables Size, Value, Momentum, Profitability, and Investment were attained. Furthermore, the four asset pricing models guiding the study to estimate expected stock returns and highlight the presence of segmentation were discussed. The sample period chosen for the study was from 01 January 1996 to 31 December 2015. The study analysed six sectors from the JSE for the effects of market anomalies by using four different asset-pricing models. The multifactor risk models were established from the famous CAPM, which is known as a single risk factor model. Furthermore, the chapter discussed the various regression statistics and described how the variables size, value, momentum, J, profitability, and investments were obtained. The above chapter gives a clear direction to execute in the next section for applied regression analysis, model specification, and variables analysis and estimate techniques about the test of the style-risk effects of JSE sector returns. Johansen and Juselius (1990) cointegration techniques and VECM were used. The study used some diagnostic test to confirm the parameters estimated outcomes that are achieved through the estimated model. Lastly, this chapter went on to outline the potential biases this study faces and the remedies that were put in place. The next chapter estimates and discusses the findings of the asset-pricing models described in this chapter.

CHAPTER FIVE: RESULTS AND DISCUSSIONS

5.1. Preamble

The debate on behavioural finance and the efficient market hypothesis is one that will go for many years. One theory advocates for market efficiency and the other opposes it. This debate strives to explain fully the relationship between risk and return. This debate is positive on the financial theory application. As researchers' debate more asset pricing model will be derived that support each financial theory that qualifies risk and translates that risk into estimates of expected return on equity. These asset pricing models are illustrated below. The aim of this research is to determine the effect market anomalies have on stock returns across sectors and which methodology better captures these market anomalies. This was done through the examination of the different asset pricing models with more emphasis on the Fama-French five-factor model and its applications. It began by discussing the theory and where the model originated from. A discussion of when and how the model is implemented and applied then followed. Ultimately, it discussed whether the five-factor model is an improvement from previous models and some of the drawbacks of the model and areas that can be improved on.

The analysis presented in this chapter illustrates that market anomalies are present on the JSE and that the use of different asset-pricing models yields to different results. This chapter is divided into three major sections. Firstly, the findings of the cross-sector analysis, where sector monthly price date was used to examine the presence of momentum anomaly on the JSE. The second section discusses the finding of the variables analysed across the 163 listed companies used in this research. This section includes the application of the CAPM, FF3FM, CH4FM and the FF5FM models in the South African Stock Market. The main emphasis put on analysing the monthly and annual price data to examine the variables size, value, profitability, and investment to establish if the FF5-factor model is applicable in the South African stock market.

The style risks identified with the Fama and French Five-Factor model (2015) tested in this section are size, value, momentum, profitability and investment effects whereas the indices identified are ALSI Top 40 return, RESI Top 10 index, INDI Top 25 Index and the FINI Top 15 index. Using the above-mentioned models, time-series regressions are perfumed to determine whether the style-risks mentioned are captured fully within their pre-determined sector indices.

The last section continues by illustrating and explaining the descriptive statistic of the FF5FM model. The section continues by explaining the regression analysis for the FF5FM, which then is followed by a discussion of the findings. The chapter concludes with a summary of the findings from both the cross-sector analysis and FF5-factor analysis of which market anomalies are consistent throughout the sectors and on the JSE.

Results and Analysis

This section provides an analysis of the result applying the framework from the asset ricing models outlined in chapter one and the analytical techniques proposed in chapter four. This section presents an overview of the estimated effects of style-risk anomalies findings. This section is subdivided into three sections, thus, Stationarity tests, cointegrations, and the regressions to test which model better explains anomalous returns. Section 5.3 presents the descriptive statistics and 5.4 presents the results of a CAPM across the full sample period, Section 5.5, 5.6 and 5.7 presents the results from the multi-factor asset pricing model tests and Section 5.8 discusses and summarises the results.

5.2. Estimation Techniques Results

5.2.1. Stationarity Test

The early and pioneering work for detecting the presence of a unit root in a time series data was developed by Dickey and Fuller (1976, 1979). The ADF results in Table 5.1.1show that comparing the ADF test statistics with their corresponding critical values, it is concluded that all the level series have unit roots and all series became stationary at order 1 after the first differencing, at the 1% significant level. Thus, all variable series were integrated with a series into the same order 1(1). To confirm the ADF test, the stationary tests are also represented graphically, which also shows that all the level series have unit roots, however, the first difference of all series made them stationary at the 1% significant level. This is confirmed by the graphs in *Figure 9*.

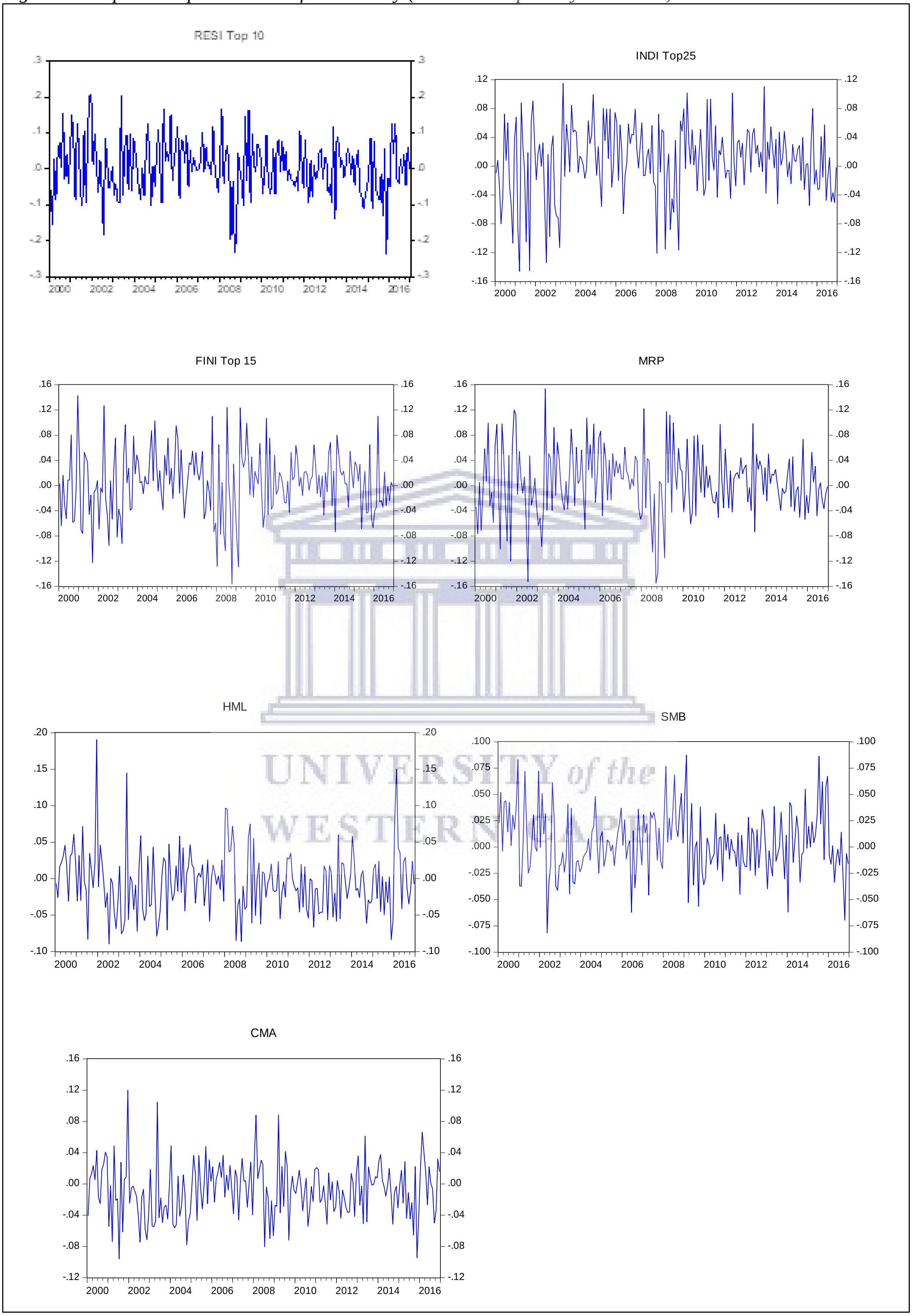
Table 5. 1: Stationarity Test Result

Augmented Dickey-Fuller				
Variables			Prob values	Order of Integration
RESI_TOP_10*		-1483038*	0.0000	I(1)
INDI_TOP_25*		-13.69089*	0.0000	I(1)
FINI_TOP_15*		-13.86646*	0.0000	I(1)
MRP*		-14.88926*	0.0000	I(1)
SMB*		-13.15255*	0.0000	I(1)
HML*		-13.06093*	0.0000	I(1)
RMW*		-14.29083*	0.0000	I(1)
CMA*		-14.04376*	0.0000	I(1)
Critical Value	***1%***	***-3.462574***		
	5%	***-2.875608***		

Source: Own Computation

*,** and *** denotes the rejection of the null hypothesis of unit root at 1%, 5%, and 10% significance levels.

Figure 8: Graphical Representation of Stationarity (Source: Compiled by the author)



All variables were tested for unit root and are trending upwards through their fluctuations. This is inclusive of both the stochastic and deterministic time trends. The results confirm the initially reported findings in the table above that all variables were not stationary at the original levels. The results above confirm the findings in the above table that revealed that all variables become stationary after first differencing. The RESI Top 10, the INDI Top 25, the FINI Top 15 and the MRP move in the same pattern. They start with a difference and take a huge difference during the 2008 financial crisis. After establishing, that all the variables are integrating of the same order (1) at the first differencing, it is crucial to find if there are long-run association explanatory and dependent variables. The log-return series appear similar but are not identical, meaning and they seem to share similar shocks or disturbances.

5.2.2. Cointegration (Results are in the Appendix)

Cointegration shows that the presence of a long-run association amongst variables. It means they are integrating the same order, but in the presence of a linear combination of at least one or more variables are integrating of order I(0). Their first criteria to be met when using the Johansen cointegration test is to indicate an optimal lag to be used. Johansen test finds the deterministic trend assumption in the VAR model and removes the serial correlation on the residuals. The optimal lag is obtained from information criteria approach, how many lags should include in the model. Table 5.2.1 to Table 5.2.12 shows the different lag-order selection information criteria. An optimum lag length is expected to produce uncorrelated and homoscedastic residuals.

Model 1: CAPM results:

Table 5.2.1 shows that trace test results reflect that cointegrated equations exist at 5% level of significance. The null hypothesis of no cointegrating vectors is rejected since the trace tests statistics of 65.28 is more than critical 15.49 at 5% level of significance. In the same analogue, Ho: = there is at most one Cointegration vector, and it falls under the rejection region meaning we reject the null hypothesis as the trace test value statistics of approximately 25.58 is greater than the critical 3.84 at 5% level of significance. The maximum eigenvalue test Table 5.2.1. reveals that the cointegrating equation exists at a 5% level of significance. The null hypothesis of no cointegrating vector is not accepted as critical the eigenvalue of 38.69 is more than the critical value 14.26 at 5% significant. At most one cointegrating vector is not accepted using the same analysis, as a test statistic of about 26.58 is more than the critical value of 3.84 at 5% significant. There is a long-run relationship between the variables based on the results of cointegration using the trace and eigenvalues. The results imply that Vector Correction Model (VECM) can now be used. This also applies to Table 5.2.2. and Table 5.2.3 results for INDI TOP 25 MRP and FINI TOP 15 MRP.

Model 2: Fama and French Three-Factor Model:

From Table 5.2.4 the max-eigenvalue test indicates 3 cointegrating equation(s) at both 5% and 1% levels. Table 5.2.5 and 5.2.6.details the 3 cointegrating equations and their adjustment coefficients. The null hypothesis of no cointegrating vectors is rejected since the trace tests statistics of 119.99 is more than critical 47.87 at 5% level of significance for RESI. In Table 5.2.6. the null hypothesis for INDI the trace test statistic of 113.39 is more than the critical value of 47.86 AT 5% level of significance. The null hypothesis of no cointegrating vectors is rejected since the trace tests statistics of 161.16 is more than critical 47.87 at 5% level of significance for FINI in Table 5.2.6.

In the same analogue for RESI, Ho: = there is at most one cointegration vector, and it falls under the rejection region meaning we reject the null hypothesis as the trace test value statistics of approximately 77.48 is greater than the critical 29.79 at 5% level of significance. The null hypothesis that the is at most 2 cointegration vector can be accepted as the trace statistic of about 46.01 is less than the critical value of 15.49 at 5 % significant and even at most 3 cointegration vector is accepted since the trace statistic of approximately 17.23 is less than the critical value of 3.84 at 5 % significance. At most four cointegration vectors are rejected since the trace statistic of roughly 0.193 is less than the critical value of 3.841 at 5% significant. Table 5.3.5 and Table 5.3.6 are results for the max-eigenvalue test results apply similarly as the results match.

The maximum eigenvalue test Table 5.2.4 reveals that the cointegrating equation exists at a 5% level of significance. The null hypothesis of no cointegrating vector is not accepted as critical the eigenvalue of 42.50 is more than the critical value 27.58 at 5% significant. At most one cointegrating vector is not accepted using the same analysis, as a test statistic of about 31.47 is more than the critical value of 21.13 at 5% significant. At most 2, the null hypothesis, failed to reject since the statistic value of 28.78 is less than the critical value of 14.26 at 5% significant. At most 3, the null hypothesis is accepted since the statistic value of about 3.44 is less than the critical values 14.26 at 5% significant. At most 4, the null hypothesis of approximately 28.78 is less than the critical value of 14.26 at 5% significant. Similar results are noted from the industrials and financial sectors against the three-factor variables. There is a long-run relationship between the variables based on the results of cointegration using the trace and eigenvalues.

Model 3: Carhart Four Factor Model:

The trace rank test for the Resources Top 10, Industrials Top 25 and Industrials Top 15's trace statistic values for the null hypothesis range between 165.33 and 213.63 which is more than the critical values at both 5% and 1% levels of significance. This means we reject the null hypothesis. These results are similar to those of the trace statistic ranks At most 1, At most 2, and At most 3 for all three sectors. Thus, the hypothesis is rejected at the 0.05 level of significance.

The max-eigenvalue test for Table 5.2.7 indicates 3 cointegrating equation(s) at both 5% and 1% levels. Tables 5.2.8.and 5.2.9 details the 3 cointegrating equations and their adjustment coefficients. The null hypothesis of no cointegrating vectors is rejected since the maximum eigenvalue test statistics which are 55.22, 54.37 and 79.89, respectively which are more than critical values 33.87 and 69.82 at 5% level of significance for RESI, INDI, and FINI. In Tables 5.3.7, 5.2.8 and 5.2.9., the max-eigenvalue tests for the null hypothesis is accepted since the statistic value is less than the critical values, for all industrial sectors.

Model 4: Fama and French Five-Factor Model:

The trace statistic and the maximum eigenvalue statistic for the Fama and French Five-Factor variables yield similar results as shown in Tables 5.2.10., 5.2.11. and 5.12. The null hypothesis of no cointegrating vector is not accepted as critical the trace and eigenvalue are below the test statistic values. There is a long-run relationship between the variables based on the results of cointegration using the trace and eigenvalues.

5.3. Descriptive Statistics of the Variables

This study aims to identify which asset pricing model is better at explaining returns and which style-based risks are evident in this South African stock market. Thus, descriptive statistics become an essential part of the analysis because they are assisting in determining if each sector and the market are associated and to what extent the return distribution compare with the normal distribution. This is done for the market return, the 6 and 12-month momentum variable for all the sectors. The descriptive statistics of all sectors are summarised in Table 5.3. The evaluation is initiated by contrasting the arithmetic mean returns in factor mimicking based on the highest and lowest percentiles. This is performed for the major sectors with emphasis on the resources, industrial and financial sectors.

Table 5.3. 1: Descriptive statistics of sectors used in research (January 2000 to December 2015)

	Mean	**Standard Deviation**	**Kurtosis**	**Skewness**	**Minimum**	**Maximum**	**Confidence Level(95,0%)**
All Share	0,0365	0,0476	0,7557	-0,2825	-0,1255	0,1616	0,0066
Top 40	0,0349	0,0507	0,8257	-0,2969	-0,1404	0,1656	0,0070
Resource 10	0,0326	0,0763	1,1538	-0,4953	-0,2563	0,2035	0,0105
Industrial 25	0,0307	0,0505	1,2984	-0,8543	-0,1510	0,1428	0,0070
Financial 15	0,0437	0,0499	0,2726	-0,0906	-0,0989	0,1775	0,0069

Source: Own estimates

As can be seen in Table 5.3, the mean value for the market return where the All-share index was used as a proxy for the market is 0,0365, while the standard deviation for the market return is 0,0476. This is indicative that the market returns did not deviate much from the mean, implying that the deviations from returns of the overall market are centred on zero. However, the distribution is skewed negatively indicated by the skewness value of -0,2825. This is supported by the kurtosis value of 0,7557, which suggests a platykurtic distribution. A platykurtic distribution has a thinner tail than a normal distribution. The maximum and minimum returns of the sample period were 0.1616 and -0.1255, respectively. The JSE Top 40 index's returns have a mean of 0.0349 and a standard deviation of 0.0507. This sector’s returns are in line with the All-Share along the deviation is slightly higher. The JSE Top 40's skewness is -0.2969 and the kurtosis is 0.8257. The maximum value is 0.1656 and the minimum value is -0.2969.

The returns of all the sectors analysed in this study indicate that most of the returns are in tandem with the All Share index except technology. The returns for the financial sector are higher than the market and have a mean value of 0.0437 and a standard deviation lower than the market of 0,0499. Thus, their returns are less volatile in this sector. The Financial sector's skewness is -0,0906 and has the lowest high kurtosis of 0,2726. Implying that the returns are above zero.

Preferably, asset pricing tests ought to be conducted on individual securities but considering there are over 170 actively trading securities on the JSE, statistical considerations force grouping of stocks into portfolios (Cochrane, 2001). Running asset pricing test on portfolios significantly reduces the impact of firm specific risk on estimation on means and other descriptive statistics. Thus, grouping allows for the decrease in the number of test assets and minimizes loss of information. This led to the study being based on sectors and the three most prominent, resources, industrial and financial sectors were chosen. These three move in tandem with the ALSI and the measure of their risk (i.e. volatility on return) is examined. The preferable method of factor construction for this study was to take into account the segmentation of the JSE into resources, financial as well as industrial shares. The factors were constructed differently separate SMB, HML, WML, RMW and RMW factors for each of these sectors. As a notation the factors are referred to as SMB Factor (Small minus large cap); HML Factor (Value minus growth); WML factor (Winner minus loser), RMW factor (Robust Minus Weak operating profitability), as well as CMA factor (Conservative Minus Aggressive investing).

Therefore, this section in Table 5.3.2.depicts the descriptive statistics of basic overview, distribution, and volatility of the return, of the factors on all the asset pricing models Furthermore, for this study, the information on whether stock returns, MRP, SMB, HML, WML, RMW, and CMA are volatile or not, is are provided.

Table 5.3. 2: Descriptive statistics of the asset pricing factor model constituents

	Mean	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Confidence Level(95,0%)
MRP	0,0060	0,0528	0,4700	-0,0968	-0,1546	0,1537	0,0073
SMB	0,0045	0,0303	0,2504	0,2260	-0,0818	0,0874	0,0042
HML	-0,0044	0,0430	2,3186	0,8381	-0,0896	0,1904	0,0059
WML	0,0460	0,0390	1,8692	0,6033	-0,0838	0,1947	0,0054
RMW	-0,0006	0,0322	1,9132	0,2649	-0,1067	0,1271	0,0044
CMA	-0,0079	0,0351	0,7517	0,2828	-0,0959	0,1198	0,0049

Source: Own estimates

The stock market benchmark returns have a mean value of 0.0104 with a standard deviation of 0.0522, which indicates that stock returns are volatile and centred on zero. In addition, the distribution is negatively skewed with a skewness value of -0.0380 suggesting an asymmetrical skewness and a kurtosis value of 0.3818. This suggests that most of the returns are slightly on the left-hand side of the distribution. In addition, outliers are present in the distribution as indicated by the maximum value of 0.1491 and a minimum value of -0.1491.

The Fama and French three factor model add the SMB and HML to the single factor model. The SMB Factor has a mean of 0.0045 and a standard deviation of 0.0303. This factor has a positive skewness of 0.2260 and kurtosis of 0.2504 indicative of a slight left-hand sided distribution of the return. The SMB Factor has a minimum value of -0,0818 and a maximum value of 0,0874. On the other hand, the value factor, HML, has a negative mean of -0.0044 and a standard deviation at 0.0430. The HML has the highest skewness of all the factors at 0,8381 and its kurtosis is 2,3186. Lastly, the minimum value of the HML is -0,0896 and the maximum value 0,1904.

The Carhart four Factor model adds the momentum factor component, thus, the WML. This has a mean value of 0,0460 and a standard deviation value of 0,0390 over 6-month period returns. This indicates that the returns are above zero; however, most of the returns are located on the right side of the distribution as indicated by the skewness value of 0,6033and the kurtosis value of 1,8692 indicative that the distribution is sharper than the normal distribution. The maximum value of 0,1947 and the minimum value of -0,0838 indicate that outliers are present in the distribution.

The Fama and French Five Factor model adds the RMW and CMA variables, which have mean values of -0.0006 and -0.0079 respectively. Their standard deviations were also negative. In addition, the RMW variable is and CMA are normally distributed with most values on the slightly on the right-hand side symmetrical skewness. The RMW Kurtosis at 1.9132 is slightly higher than that of the CMA (0.7517) The HML and the CMA values indicate that they are in tandem and are equally volatile. Thus, as evident for the descriptive statistics above that there are significant amounts of volatility on the JSE. This implies that investors and practitioners will seek to be compensated for the risk inherited in the market.

Objective One: Findings - Cross-Sector Analysis using the CAPM

5.4. Capital Asset Pricing Model

It is evident that the market returns almost some perform similarly in the market throughout of the investment period but the above did not show the extent to which market anomalies are evident in each sector. Therefore, the results to be presented are according to the asset pricing model. First, the analysis of the CAPM will be discussed. This is the model that the majority have criticized that it does not explain the returns full as it relies only on the MRP.

This section presents the results of the CAPM conducted in the three major sectors of the JSE considered for this study. Tables 5.4.1, 5.4.2 and 5.4.3 illustrate the results of the RESI Top 10, INDI Top 25 and FINI Top 15 for the full sample period from 2000 to 2016.

Table 5.4. 1: RESI TOP 10 CAPM

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 402				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-1.184227	0.178408	-6.637732	0.0000
C(3)	**-0.346180**	**0.150370**	**-2.302182**	**0.0219**
C(4)	**0.832743**	**0.312310**	**2.666396**	**0.0080**
C(5)	0.091331	0.232620	0.392617	0.6948
C(6)	**0.000903**	**0.005923**	**0.152482**	**0.8789**
Determinant residual covariance		4.78E-06		
Equation: D(RESI_TOP_10) = C(2)*D(RESI_TOP_10(-1)) +C(3)*D(RESI_TOP_10(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) + C(6)				
Observations: 201				
R-squared	0.468031	Mean dependent var		-0.000136
Adjusted R-squared	0.454391	S.D. dependent var		0.113666
S.E. of regression	0.083960	Sum squared resid		1.374610
Durbin-Watson stat	2.112766			

Table 5.4. 2: INDI TOP 25 CAPM

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 402				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	0.425520	0.177463	2.397800	0.0170
C(3)	0.095152	0.135957	0.699868	0.4844
C(4)	**-0.756788**	**0.138423**	**-5.467225**	**0.0000**
C(5)	**-0.278559**	**0.119458**	**-2.331861**	**0.0202**
C(6)	**0.000495**	**0.003645**	**0.135732**	**0.8921**
Determinant residual covariance		2.38E-06		
Equation: D(INDI_TOP25) = C(2)*D(INDI_TOP25(-1)) + C(3)*D(INDI_TOP25(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) + C(6)				
Observations: 201				
R-squared	0.470954	Mean dependent var		0.000127
Adjusted R-squared	0.457388	S.D. dependent var		0.070118
S.E. of regression	0.051650	Sum squared resid		0.520212
Durbin-Watson stat	2.055748			

Table 5.4. 3: FINI TOP 15 CAPM

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 402				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	0.382499	0.117255	3.262119	0.0012
C(3)	0.275832	0.089849	3.069956	0.0023
C(4)	**-0.414482**	**0.077891**	**-5.321280**	**0.0000**
C(5)	**-0.273586**	**0.076817**	**-3.561517**	**0.0004**
C(6)	**-5.79E-05**	**0.003559**	**-0.016266**	**0.9870**
Determinant residual covariance		4.69E-06		
Equation: D(FINI_TOP_15) = C(2)*D(FINI_TOP_15(-1)) + C(3)*D(FINI_TOP_15(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) +C(6)				
Observations: 201				
R-squared	0.520095	Mean dependent var		-8.87E-05
Adjusted R-squared	0.507789	S.D. dependent var		0.071923
S.E. of regression	0.050459	Sum squared resid		0.496501
Durbin-Watson stat	1.976396			

The regression results of the CAPM are presented in Tables 5.4.1, 5.4.2 and 5.4.3. The results show that the CAPM model captures some of the variations in sectors returns with the R-Squared. The FINI Top 15 index R-squared is 0.5201 which is the highest followed by the INDI Top 15 index at 0.4709 and the lowest is RESI Top 10 index R-Squared at 0.4680. The R-squared for the resources index is not consistent with these sectors' allocation of the ALSI index.

The results in Table 5.4.1.for the MRP Lag 1, C (4), and MRP Lag 2, C5, variables represent the MRP coefficient for the RESI Top 10 Index. The coefficient of MRP Lag 1 is 0.8327 and is statistically significant. On the other hand, MRP Lag 2 is at 0.09113 and is statistically insignificant in explaining the sector returns. The speed of the coefficient represented by C (6) is 0.000903 monthly. For the year that will be 1.08%. This implies that any structural changes in the parameters would mean 1.08% shift away from the equilibrium within the year**.**

The MRP Lag 1 and MRP Lag 2 coefficients for the INDI Top 25 are -0.7568 and -0.2785, respectively. They are both statistically significant. Thus, 1% in the market risk premium will negatively affect the industrials sector. The C (6) monthly coefficient is 0.000495, thus, annually and change 0.594%. This implies that any structural changes in the parameters would mean 0.594% shift away from the equilibrium within the year. For the FINI TOP 15 variables in Table 5.3.2. for the MRP Lag 1 and MRP Lag 2 are -0.4145 and -0.2736, respectively and are both statistically significant. Thus, a 1% change in the market risk premium will cause a negative change in the financial sector returns. However, the speed of adjustment is C (6) is statistically insignificant.

The results from the CAPM alone in section 5.3 show that the market risk premium falls shorts in explaining returns alone. The results show that the risk-free rate was restricted in the CAPM. The market premium (RM-RF) and the risk-free rate for all sectors are significant at the 1 percent significance level. It is evident from these results that the CAPM can account for returns across the sectors and, according to the theory of EMH, it could be said that the sectors examined in this study are efficient. However, CAPM is known as a single risk factor and thus only accounts for market risk. CAPM, therefore, only applies when no additional variables are included in the model. As a result, the CAPM cannot account for the effects of market anomalies. This is evident for the R-Squared from all three sectors where only the financial sector has results that can be explained above 52%.

The CAPM is used as a benchmark in the sub-sections that follow where other asset pricing models have been used to examine the effects of market anomalies. The CAPM was chosen as a benchmark because all the models in this study are extensions of the model and thus its comparison of the different asset pricing models to the CAPM helps to give more insight to which model best captures the market anomalies analysed. It is evident that the market returns almost some perform similarly in the market throughout of the investment period but the above did not show the extent to which market anomalies are evident in each sector.

Van Rensburg and Robertson (2003) suggest that the CAPM is unable to explain the generation of returns on the JSE. In developed economies shown in the study by Jorion & Schwartz (1986) also show that the CAPM is not a good description of the country's securities. However, in emerging economies like Hungary (Andor, et al., 1999) and Uganda (Wakyiku, 2010) the CAPM acceptably describes the country's capital market, thus, the traditional form of CAPM to holds. This study, however, showed that the CAPM does not offer a good account of the relationship between market risk and returns. Thus,

Objective Two: Findings - Cross-Sector Analysis using Multi-Factor Models

5.5. Fama and French three-factor model

Regression Results

The CAPM has been widely criticized that it is not a very efficient predictor of expected return given there is only one risk premium considered. The results above suggest that risk premium. The theory of CAPM states that investors earn a minimum required rate of return equal to the risk-free rate; therefore, it is of importance to examine if this notion holds when applied to the FF3-factor model, as it was derived from the CAPM. The results presented in this section illustrate that when the risk-free rate is restricted (when the risk-free rate is included as the regression intercept) the model tends to have more predictive power. Moreover, the Wald coefficient restriction test was first used to test whether the two factors added to CAPM are jointly different from zero. If the coefficients are jointly equal to zero, it implies that the variables included to the CAPM do not jointly capture additional return variations missed by the CAPM. However, if the additional variables incorporated into the CAPM are jointly different from zero, it then suggests that the additional variable jointly captures return variation missed by the CAPM and this implies that multi-risk factor models are better at capturing the effects of market anomalies across sectors. The study presented the findings of the cross-sector analysis; however, the results of the model that performed better were then discussed.

Table 5.5. 1: RESI TOP 10 Fama and French Three-Factor Model

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 804				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.419790	0.213331	-1.967787	0.0495
C(3)	0.009291	0.181479	0.051194	0.9592
C(4)	-0.120180	0.215150	-0.558587	0.5766
C(5)	**-0.377221**	**0.216475**	**-1.742557**	**0.0818**
C(6)	**0.631443**	**0.241740**	**2.612072**	**0.0092**
C(7)	**0.333555**	**0.201126**	**1.658432**	**0.0976**
C(8)	**-0.600044**	**0.260230**	**-2.305826**	**0.0214**
C(9)	-0.177546	0.195436	-0.908462	0.3639
C(10)	**0.000822**	**0.006011**	**0.136798**	**0.8912**
Determinant residual covariance		4.68E-12		
Equation: D(RESI_TOP_10) = C(2)*D(RESI_TOP_10(-1)) + C(3)*D(RESI_TOP_10(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) + C(6)*D(SMB(-1)) + C(7)*D(SMB(-2)) + C(8)*D(HML(-1)) + C(9)*D(HML(-2)) + C(10)				
Observations: 201				

R-squared	0.463504	Mean dependent var		-0.000136
Adjusted R-squared	0.438224	S.D. dependent var		0.113666
S.E. of regression	0.085195	Sum squared resid		1.386310
Durbin-Watson stat	2.141373			

Table 5.5. 2: INDI Top 25 Fama and French Three-Factor Model

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 804				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.476398	0.202300	-2.354914	0.0188
C(3)	-0.300116	0.160030	-1.875370	0.0611
C(4)	-0.187412	0.238300	-0.786453	0.4318
C(5)	-0.100292	0.176648	-0.567747	0.5704
C(6)	-0.054728	0.155501	-0.351949	0.7250
C(7)	0.131462	0.120284	1.092931	0.2748
C(8)	0.133551	0.138094	0.967099	0.3338
C(9)	**0.244832**	**0.123893**	**1.976156**	**0.0485**
C(10)	**0.000174**	**0.003980**	**0.043650**	**0.9652**
Determinant residual covariance		2.78E-12		
Equation: D(INDI_TOP25) = C(2)*D(INDI_TOP25(-1)) + C(3)*D(INDI_TOP25(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) + C(6)*D(HML(-1)) + C(7)*D(HML(-2)) + C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)				
Observations: 201				
R-squared	0.382072	Mean dependent var		0.000127
Adjusted R-squared	0.352955	S.D. dependent var		0.070118
S.E. of regression	0.056402	Sum squared resid		0.607610
Durbin-Watson stat	2.242138			

Table 5.5.3: FINI Top 15 Fama and French Three-Factor Model

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 804				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	0.347764	0.148402	2.343396	0.0194
C(3)	0.309416	0.106256	2.911977	0.0037
C(4)	**0.484425**	**0.101629**	**4.766585**	**0.0000**
C(5)	**0.394994**	**0.090459**	**4.366546**	**0.0000**
C(6)	**-0.637192**	**0.108830**	**-5.854906**	**0.0000**
C(7)	**-0.475310**	**0.095203**	**-4.992589**	**0.0000**
C(8)	**0.258083**	**0.111920**	**2.305951**	**0.0214**
C(9)	**0.249751**	**0.109377**	**2.283389**	**0.0227**
C(10)	**0.000109**	**0.003742**	**0.029224**	**0.9767**
Determinant residual covariance		5.90E-12		
Equation: D(FINI_TOP_15) = C(2)*D(FINI_TOP_15(-1)) + C(3)*D(FINI_TOP_15(-2)) + C(4)*D(HML(-1)) + C(5)*D(HML(-2)) + C(6)*D(MRP(-1)) + C(7)*D(MRP(-2)) + C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)				
Observations: 201				
R-squared	0.480708	Mean dependent var		-8.87E-05
Adjusted R-squared	0.456239	S.D. dependent var		0.071923
S.E. of regression	0.053036	Sum squared resid		0.537249
Durbin-Watson stat	2.145314			

The regression results for the Fama and French (1992, 1993) three-factor model are presented in Tables 5.5.1, 5.5.2 and 5.5.3. The results show that the three-factor model captures much of the variation in sector returns with the R-Squared for the FINI Top 15 index the highest at 0.4801 followed by the RESI Top 10 index at 0.4635. The R-Squared for the INDI Top 25 is the lowest at 0.3821.

In Table 5.5.1.when testing the three-factor model C(4) to C(10) are of interest as they represent the variables of interest for the RESI Top 10 index. The MRP lag 1's, C(4), the coefficient is -0.1202 and is statistically insignificant. The MRP lag 2's, C(5), coefficient at -0.3772 is statistically significant a 10 %, however, for this study, the 5% and 1% significance levels are of importance. The C(6) which is the SMB Lag 1 is statistically significant with a coefficient of 0.6314. However, at SMB Lag 2, C(7) is statistically insignificant. The HML Lag 1 (C(8))'s coefficient is -0.6004 and is statistically significant. However, HML lag 2 is negatively insignificant. The speed of adjustment C(10) coefficient is 0.000822. This implies that any structural changes in the parameters would mean 0.98% shift away from the equilibrium within the year.

The regression results for the Industrial Top 25 index for the full sample period are shown in Table 5.5.2. For the industrial sector only the SMB Lag 2, C9, is the only statistically significant variable with a coefficient of 0.2448. The industrial sector's speed of adjustment for monthly returns is 0.0017. The annual figure would be 0.209%. This implies that any structural changes in the parameters would mean 0.209% shift away from the equilibrium within the year**.**

The HML coefficients of the FINI Top 15 for Lag 1 C(4) and Lag 2 C(5) are 0.4844 and 0.3950, respectively and are statistically positively significant. The MRP Lag 1 and Lag 2 coefficients are negatively statistically significant with coefficients of -0.6372 and -0.4753. The coefficients for the SMB Lag 1 and Lag 2 are 0.2581 and 0.2497, respectively. These size factors are statistically significant. For the speed of adjustment, a monthly coefficient of 0.000109 is present. This implies that any structural changes in the parameters would mean 0.1308% shift away from the equilibrium within the year.

Table 5.5.4: Summary of styles present in sectors using FF3FM

	RESI Top 10	**INDI Top 25**	**FINI Top 15**
MRP	N/A	N/A	Market risk neg*
HML	Mild growth bias	N/A	Value bias*
SMB	Small-cap bias*	Mild small-cap bias	Small-cap bias*

Source: Compiled by the author

Although there is extensive research done and being done on this topic, there has been no consensus on the effect market anomalies have on the expected returns. Table 5.4.4. contains a summary of the Fama and French (1992,1993) three-factor model used and the market anomalies captured in all the three sectors. The small-cap bias is present fully in the industrial and financial sectors. Value bias is only present in the financial sector. The mild growth bias and the mild small-cap bias indicate some presence but were not statistically significant.

Graham and Uliana (2001) examined the JSE industrial sector and found the existence of the value growth effect in the South African market. In this study, the industrial sector over the study period does not display the same result. This could be due to the differing time period of research as Graham and Uliana's study covered the period 1987 to 1992 and a different methodology was implemented. A study by Bhana (2014) over the examination period January 1997 to December 2012 found that value portfolios outperformed growth portfolios constantly on a risk-adjusted basis. The value anomaly is subject to financial sectors, thus, implying a positive relationship between security returns and the ratio of accounting-based measures of value to the market price of the security.

Strugnell, Gilbert, and Kruger (2011) on examining the period between January 1994 and October 2007 found the persistence of size and value (proxied by the price-earnings effects) in the cross-section of returns on the JSE. In this study, the size proxy premium is concentrated on small stocks on the JSE with no significant. Similar to this study there is evidence of strong small stocks on the JSE resources, industrial and financial sectors, showing that small capitalization stocks outperformed large capitalization stocks.

Auret and Cline (2011) using all ALSI constituents between 1988 to December 2006 found no significant support for the value and size effect anomaly on the JSE. Thus, implying the existence of the size (small cap) and value anomalies on the JSE. However, the Fama and French three factor model seems to only be partially explaining the value anomaly and there in mild presence of growth. Similarly, to Boamah (2015), this model partially explains the value and size anomalies. This implies further investigation or addition or more factors is necessary. Thus; investors who could beat the ALSI had small cap securities.

5.6. Carhart Four Factor Model using 6-month holding period

The Carhart four-factor model is an extension of the three-factor models as it includes another essential variable known as momentum. Some research has proven that this additional variable can account for some of the excess return, not captures by the market risk, size and value variables. The study included the six-month momentum variables only due to limited data prior to 2000. This six-month momentum variable effect will be used short term horizon. Presented below is the cross-sector analysis of the CH4FM with and without the CAPM assumption for the 6-month momentum returns. The results shown from Tables 5.6.1 to 5.6.9 are regression results from three periods, thus, 2000 – 2016 the full sample period, 2000 – 2008 and 2009 – 2016. This was done to clearly show the performance of the sectors in a different time period and its ability to predict returns through both the bearish and bullish markets.

5.6.1. Regression Results

The regression results of the Carhart (1997) four-factor model are presented in Tables 5.6.1., 5.6.2, 5.6.3., 5.6.4., 5.6.5., 5.6.6., 5.6.7., 5.6.8 and 5.6.9. For the regression result below C (4) and C(5) represent Lag 1 and Lag 2 for the MRP. The HML Lag 1 and Lag 2 are represented by the C(6) and C(7). The variables C(8) and C(9) are for the Lag 1 and Lag 2 for the SMB. Lastly, C(10) and C(11) represent Lag 1 and Lag 2 for the WML variable.

Table 5.6.1: CH4FM RESI Top 10 2000 – 2016

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 1005				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.492149	0.182606	-2.695143	0.0072
C(3)	-0.054355	0.173275	-0.313692	0.7538
C(4)	-0.160054	0.212021	-0.754894	0.4505
C(5)	**-0.382013**	**0.213626**	**-1.788230**	**0.0741**
C(6)	**-0.631375**	**0.209096**	**-3.019538**	**0.0026**
C(7)	-0.204740	0.177979	-1.150362	0.2503
C(8)	**0.946710**	**0.253052**	**3.741168**	**0.0002**
C(9)	**0.494147**	**0.204593**	**2.415267**	**0.0159**
C(10)	**-0.614879**	**0.212952**	**-2.887406**	**0.0040**
C(11)	**-0.389580**	**0.171222**	**-2.275295**	**0.0231**
C(12)	**0.000787**	**0.005909**	**0.133160**	**0.8941**
Determinant residual covariance		5.39E-15		
Equation: D(RESI_TOP_10) = C(2)*D(RESI_TOP_10(-1)) + C(3)*D(RESI_TOP_10(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) +C(6)*D(HML(-1)) + C(7)*D(HML(-2)) + C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(WML(-1)) + C(11)*D(WML(-2)) + C(12)				
Observations: 201				
R-squared	0.487019	Mean dependent var		-0.000136
Adjusted R-squared	0.457163	S.D. dependent var		0.113666
S.E. of regression	0.083746	Sum squared resid		1.325546
Durbin-Watson stat	2.159925			

Table 5.6.2: CH4FM INDI Top 25 2000 – 2016

Estimation Method: Least Squares			
Sample: 2000M04 2016M12			
Included observations: 201			
Total system (balanced) observations 1005			

	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.584665	0.156487	-3.736184	0.0002
C(3)	-0.334869	0.148147	-2.260387	0.0240
C(4)	-0.200625	0.130749	-1.534430	0.1253
C(5)	0.057178	0.114542	0.499186	0.6178
C(6)	-0.067257	0.175051	-0.384217	0.7009
C(7)	-0.065614	0.162813	-0.403005	0.6870
C(8)	**0.334341**	**0.162009**	**2.063722**	**0.0393**
C(9)	**0.346002**	**0.133257**	**2.596505**	**0.0096**
C(10)	-0.224332	0.146206	-1.534356	0.1253
C(11)	-0.130332	0.115307	-1.130303	0.2586
C(12)	**0.000129**	**0.003973**	**0.032570**	**0.9740**
Determinant residual covariance		3.33E-15		
Equation: D(INDI_TOP25) = C(2)*D(INDI_TOP25(-1)) + C(3)*D(INDI_TOP25(-2)) + C(4)*D(HML(-1)) + C(5)*D(HML(-2)) + C(6)*D(MRP(-1)) + C(7)*D(MRP(-2)) + C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(WML(-1)) + C(11)*D(WML(-2)) + C(12)				
Observations: 201				
R-squared	0.390664	Mean dependent var		0.000127
Adjusted R-squared	0.355200	S.D. dependent var		0.070118
S.E. of regression	0.056304	Sum squared resid		0.599162
Durbin-Watson stat	2.238280			

Table 5.6.3: CH4FM FINI Top 15 2000 – 2016

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 1005				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	0.212627	0.139494	1.524272	0.1278
C(3)	0.237988	0.103702	2.294910	0.0220
C(4)	**0.374455**	**0.098056**	**3.818796**	**0.0001**
C(5)	**0.340608**	**0.092080**	**3.699038**	**0.0002**
C(6)	**-0.622687**	**0.113411**	**-5.490524**	**0.0000**
C(7)	**-0.472293**	**0.101217**	**-4.666153**	**0.0000**
C(8)	**0.407520**	**0.125275**	**3.253007**	**0.0012**
C(9)	**0.333726**	**0.116650**	**2.860909**	**0.0043**
C(10)	**-0.292242**	**0.109742**	**-2.662988**	**0.0079**
C(11)	**-0.156472**	**0.101551**	**-1.540830**	**0.1237**
C(12)	**0.000107**	**0.003808**	**0.028105**	**0.9776**
Determinant residual covariance		7.35E-15		
Equation: D(FINI_TOP_15) = C(2)*D(FINI_TOP_15(-1)) + C(3)*D(FINI_TOP_15(-2)) + C(4)*D(HML(-1)) +C(5)*D(HML(-2)) + C(6)*D(MRP(-1)) + C(7)*D(MRP(-2)) +C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(WML(-1)) + C(11)*D(WML(-2)) + C(12)				
Observations: 201				
R-squared	0.467965	Mean dependent var		-8.87E-05
Adjusted R-squared	0.437000	S.D. dependent var		0.071923
S.E. of regression	0.053966	Sum squared resid		0.550433
Durbin-Watson stat	2.157940			

The results from Table 5.6.1, 5.6.2 and 5.6.3, are for the full sample period. These results show that the R-Squared for the RESI Top 10 index is the highest at 0.4870. This is followed by the FINI Top 15 index at 0.4679 and the lowest in the INDI Top 25 index at 0.3906.

Table 5.6.1 shows the regression results in the Carhart four-factor model for the full sample period for the RESI Top 10 index. The MRP Lag 1 and Lag 2 are both negatively insignificant. The lag 1 for the HML is -0.6314 and is statistically significant. However, Lag 2 for the value factor is negatively insignificant. The SMB Lag 1 and Lag 2 are 0.9467 and 0.4941, respectively and are both statistically significant. The coefficients for WML Lag 1 and Lag 2 are -0.6149 and -0.3896 and are both statistically significant. The Speed of adjustment monthly value is 0.000787. This implies that any structural changes in the parameters would mean 0.944% shift away from the equilibrium within the year.

Table 5.6.2 represents the CH4FM model results for the INDI Top 25 results. The MRP Lag 1 coefficient is statistically insignificant and the MRP Lag 2 is positively insignificant at 0.0572. The HML Lag 1 and Lag 2 are both negatively insignificant. The SMB factor Lag 1 coefficient is 0.3343 and the Lag 2 is 0.3460. They are both positively significant implying that the period from 2000 to 2016 has a size bias. The WML variables for both Lag 1 and Lag 2 are negatively insignificant. The speed of adjustment is 0.000129 monthly. This implies that any structural changes in the parameters would mean 0.155% shift away from the equilibrium within the year.

Table 5.6.3 shows the regression results for the FINI Top 15 index. The MRP Lag 1 and Lag 2 coefficients are 0.3744 and 0.3406 and are both statistically significant. The HML coefficients for Lag 1 and Lag 2 are -0.6227 and -0.4723 and are statistically at 0.00. The negative coefficient to the HML risk factor suggests that most of the stocks in the resources sector are growth stocks. The WML coefficients for Lag 1 and Lag 2 are -0.2922 and -0.1565. The WML Lag 1 is statistically significant and the Lag 2 is negatively insignificant. The negative coefficient to the WML risk factor suggests a contrarian bias. The speed of adjustment on a monthly basis is 0.000107%, thus, implying that any structural changes in the parameters would mean 0.1284% shift away from the equilibrium within the year.

5.6.2. Structural Breaks: 2000 -2008

Table 5.6. 4: CH4FM RESI Top 10 2000 – 2008

Estimation Method: Least Squares				
Sample: 2000M04 2008M12				
Included observations: 105				
Total system (balanced) observations 525				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.230371	0.293436	-0.785080	0.4328
C(3)	-0.062642	0.279171	-0.224386	0.8226
C(4)	-0.202027	0.352989	-0.572332	0.5674
C(5)	-0.188724	0.354219	-0.532788	0.5944
C(6)	**-1.138063**	**0.324933**	**-3.502453**	**0.0005**
C(7)	**-0.525475**	**0.262206**	**-2.004051**	**0.0456**
C(8)	**1.616758**	**0.414083**	**3.904430**	**0.0001**
C(9)	**0.797198**	**0.323210**	**2.466501**	**0.0140**
C(10)	**-0.566534**	**0.263436**	**-2.150558**	**0.0320**
C(11)	**-0.401404**	**0.215756**	**-1.860456**	**0.0635**
C(12)	**-0.000274**	**0.008836**	**-0.031006**	**0.9753**
Determinant residual covariance		5.97E-15		
Equation: D(RESI_TOP_10) = C(2)*D(RESI_TOP_10(-1)) + C(3)*D(RESI_TOP_10(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) +C(6)*D(HML(-1)) + C(7)*D(HML(-2)) + C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(WML(-1)) + C(11)*D(WML(-2)) + C(12)				
Observations: 105				
R-squared	0.488396	Mean dependent var		-0.000292
Adjusted R-squared	0.427884	S.D. dependent var		0.119588
S.E. of regression	0.090454	Sum squared resid		0.760926
Durbin-Watson stat	2.066503			

Table 5.6. 5: CH4FM INDI Top 25 2000 – 2008

Estimation Method: Least Squares				
Sample: 2000M04 2008M12				
Included observations: 105				
Total system (balanced) observations 525				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.538311	0.198176	-2.716324	0.0068
C(3)	-0.249609	0.198792	-1.255630	0.2099
C(4)	**-0.357083**	**0.210417**	**-1.697024**	**0.0904**
C(5)	**-0.155107**	**0.176885**	**-0.876882**	**0.3810**
C(6)	-0.067269	0.241266	-0.278815	0.7805
C(7)	-0.050891	0.226587	-0.224601	0.8224
C(8)	**0.810148**	**0.289464**	**2.798784**	**0.0053**

C(9)	**0.690688**	**0.221830**	**3.113595**	**0.0020**
C(10)	-0.163623	0.188817	-0.866570	0.3866
C(11)	-0.121196	0.153905	-0.787476	0.4314
C(12)	**2.06E-05**	**0.006195**	**0.003318**	**0.9974**
Determinant residual covariance		6.52E-15		
Equation: D(INDI_TOP25) = C(2)*D(INDI_TOP25(-1)) + C(3)*D(INDI_TOP25(-2)) + C(4)*D(HML(-1)) + C(5)*D(HML(-2)) + C(6)*D(MRP(-1)) + C(7)*D(MRP(-2)) + C(8) *D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(WML(-1)) + C(11)*D(WML(-2)) + C(12)				
Observations: 105				
R-squared	0.406777	Mean dependent var		0.000601
Adjusted R-squared	0.336611	S.D. dependent var		0.077843
S.E. of regression	0.063402	Sum squared resid		0.373842
Durbin-Watson stat	2.190387			

Table 5.6. 6: CH4FM FINI Top 15 2000 – 2008

Estimation Method: Least Squares				
Sample: 2000M04 2008M12				
Included observations: 105				
Total system (balanced) observations 525				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	0.459176	0.210424	2.182153	0.0296
C(3)	0.346453	0.159873	2.167053	0.0307
C(4)	**0.557024**	**0.182105**	**3.058801**	**0.0024**
C(5)	**0.275519**	**0.156102**	**1.764987**	**0.0782**
C(6)	**-0.889186**	**0.183852**	**-4.836424**	**0.0000**
C(7)	**-0.509719**	**0.154351**	**-3.302342**	**0.0010**
C(8)	**0.323080**	**0.194406**	**1.661882**	**0.0972**
C(9)	**0.423655**	**0.196663**	**2.154212**	**0.0317**
C(10)	**-0.472550**	**0.146333**	**-3.229274**	**0.0013**
C(11)	**-0.269607**	**0.136368**	**-1.977046**	**0.0486**
C(12)	**-0.000136**	**0.005709**	**-0.023874**	**0.9810**
Determinant residual covariance		1.16E-14		
Equation: D(FINI_TOP_15) = C(2)*D(FINI_TOP_15(-1)) + C(3)*D(FINI_TOP_15(-2)) + C(4)*D(HML(-1)) + C(5)*D(HML(-2)) + C(6)*D(MRP(-1)) + C(7)*D(MRP(-2)) +C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(WML(-1)) + C(11)*D(WML(-2)) + C(12)				
Observations: 105				
R-squared	0.503604	Mean dependent var		-0.000436
Adjusted R-squared	0.444890	S.D. dependent var		0.078483
S.E. of regression	0.058474	Sum squared resid		0.317988
Durbin-Watson stat	2.106948			

The results shown from Tables 5.6.4., 5.6.5 and 5.6.6 are for the first structural break which is pre-the 2008 financial crisis. These results show that the four-factor model captures some of the variations in sector returns with the for the INDI Top 25 index the lowest at 0.4068. The FINI Top 15 index has the highest R-squared at 0.5036, followed by the RESI Top 10 index at 0.4884.

Regressing the excess returns of the RESI Top 10 index onto the risk factors, the results exhibit coefficients and probability values of -1.1381 (0.0005) and -0.5255 (0.0456) to the HML risk factor, Similarly, regressing the excess returns of the resources index onto the SMB risk factors exhibits a coefficient of 1.6167 (0.0001) and 0.7972 (0.0140). Thus, showing strong sensitivities to the SMB risk factor, sector performance for the resources sector degree has a small-cap bias. The WML risk factor coefficients for lag 1 and lag 2 are -0.5665 and -0.4014, and their probability values are 0.0320 and 0.0635, respectively. Although the coefficients are statistically significant and for the most part represent strong sensitivities to each of the WML style risk factors, the negative coefficients suggest that the financial sector have a contrarian bias at various times over the 2000 to 2008 sample period. The speed of adjustment is -0.000274 monthly. This implies that any structural changes in the parameters would mean -0.3288% shift towards the equilibrium within the year.

Regressing the excess returns of the INDI Top 25 onto the four risk factors, for instance, exhibits a coefficient of -0.35701 and-0.1551 for Lag 1 and Lag 2, and a probability value of 0.0904 and 0.3810 to the HML risk factor. The MRP lag 1 and lag 2 coefficients -0.0673 and -0.0509 and are statistically insignificant. The regression results from the SMB risk factor further show sensitivities to the industrial index. The SMB risk factors coefficients are 0.8101 (0.0053) and 0.6907 (0.0020). Thus, most of the stocks in the industrial sector are small capitalisation stocks. Lastly, the WML Lag 1 and Lag 2 coefficients with the probability values displayed in brackets are -0.1636 (0.3866) and --0.1212 (0.4314). Thus, the WML risk factor sensitivities to the industrial index represent relatively mild sensitivities. The speed of adjustment for the INDI Top 25 index is 2.06E-0 implying that any structural changes in the parameters would mean a shift away from the equilibrium within the period.

The FINI Top 15 index HML coefficients for Lag 1 and Lag 2 are 0.5570 and 0.2755, respectively. Their probability values are 0.0024 and 0.0782. The MRP Lag 1 and Lag 2 coefficient are -0.8892 and -0.5097 and are both statistically significant at 1%. Adding on the SMB risk factor's Lag 1 and Lag 2 coefficient are 0.3231 and 0.4236. Their probability values are 0.0972 and 0.0317. On the other hand, regressing the excess returns of the FINI Top 15 index onto the risk factors, the results show that the WML coefficient offers high negative sensitivity and that is statistically significant. Thus, implying a contrarian bias exists. The speed of adjustments (C(12)) has a negative coefficient of -0.000136, therefore, implying that any structural changes in the parameters would mean 0.1632% shift away from the equilibrium within the year.

5.6.3. Structural Breaks: 2009 -2016

Table 5.6. 7: CH4FM RESI Top 10 2009 – 2016

Estimation Method: Least Squares				
Sample: 2009M04 2016M12				
Included observations: 93				
Total system (balanced) observations 465				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.998420	0.334640	-2.983563	0.0030
C(3)	-0.373043	0.265660	-1.404215	0.1610
C(4)	-0.266340	0.357558	-0.744885	0.4568
C(5)	-0.358247	0.277203	-1.292364	0.1970
C(6)	0.077840	0.336942	0.231018	0.8174
C(7)	-0.131171	0.306325	-0.428209	0.6687
C(8)	0.121472	0.504164	0.240938	0.8097
C(9)	-0.085245	0.338904	-0.251530	0.8015
C(10)	0.338098	0.351570	0.961681	0.3368
C(11)	**0.452197**	**0.267716**	**1.689096**	**0.0920**
C(12)	**-0.000711**	**0.007661**	**-0.092869**	**0.9261**
Determinant residual covariance		4.22E-16		
Equation: D(RESI_TOP_10) =C(2)*D(RESI_TOP_10(-1)) + C(3)*D(RESI_TOP_10(-2)) + C(4)*D(SMB(-1)) + C(5)*D(SMB(-2)) +C(6)*D(WML(-1)) + C(7)*D(WML(-2)) + C(8)*D(MRP(-1)) + C(9)*D(MRP(-2)) + C(10)*D(HML(-1)) + C(11)*D(HML(-2)) + C(12)				
Observations: 93				
R-squared	0.575210	Mean dependent var		-0.001567
Adjusted R-squared	0.517523	S.D. dependent var		0.105825
S.E. of regression	0.073506	Sum squared resid		0.437659
Durbin-Watson stat	2.098837			

Table 5.6. 8: CH4FM INDI Top 25 2009 – 2016

Estimation Method: Least Squares				
Sample: 2009M04 2016M12				
Included observations: 93				
Total system (balanced) observations 465				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.403918	0.319228	-1.265297	0.2065
C(3)	-0.143793	0.282158	-0.509620	0.6106
C(4)	0.167169	0.171516	0.974658	0.3303

C(5)	**0.310227**	**0.141077**	**2.198990**	**0.0284**
C(6)	-0.005293	0.282615	-0.018728	0.9851
C(7)	-0.047761	0.279022	-0.171173	0.8642
C(8)	**-0.523226**	**0.151671**	**-3.449745**	**0.0006**
C(9)	**-0.312130**	**0.146850**	**-2.125494**	**0.0342**
C(10)	**0.351042**	**0.182660**	**1.921827**	**0.0553**
C(11)	0.064266	0.157423	0.408238	0.6833
C(12)	**-0.001324**	**0.004164**	**-0.317934**	**0.7507**
Determinant residual covariance		1.45E-16		
Equation: D(INDI_TOP25) =C(2)*D(INDI_TOP25(-1)) + C(3)*D(INDI_TOP25(-2)) + C(4)*D(HML(-1)) + C(5)*D(HML(-2)) + C(6)*D(MRP(-1)) + C(7)*D(MRP(-2)) + C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(WML(-1)) + C(11)*D(WML(-2)) + C(12)				
Observations: 93				
R-squared	0.580895	Mean dependent var		-0.000692
Adjusted R-squared	0.523979	S.D. dependent var		0.057952
S.E. of regression	0.039983	Sum squared resid		0.129491
Durbin-Watson stat	2.178164			

Table 5.6. 9: CH4FM FINI Top 15 2009 – 2016

Estimation Method: Least Squares				
Sample: 2009M04 2016M12				
Included observations: 93				
Total system (balanced) observations 465				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.641396	0.164589	-3.896951	0.0001
C(3)	-0.204280	0.134546	-1.518290	0.1297
C(4)	0.152519	0.126263	1.207944	0.2278
C(5)	**0.390980**	**0.117787**	**3.319373**	**0.0010**
C(6)	-0.043365	0.270202	-0.160490	0.8726
C(7)	-0.200787	0.178330	-1.125928	0.2609
C(8)	**-0.297604**	**0.160361**	**-1.855840**	**0.0642**
C(9)	-0.169480	0.149897	-1.130644	0.2589
C(10)	**0.382290**	**0.187357**	**2.040435**	**0.0420**
C(11)	0.227115	0.164368	1.381750	0.1678
C(12)	**-0.000769**	**0.004521**	**-0.170018**	**0.8651**
Determinant residual covariance		4.79E-16		
Equation: D(FINI_TOP_15) = C(2)*D(FINI_TOP_15(-1)) + C(3)*D(FINI_TOP_15(-2)) + C(4)*D(HML(-1)) + C(5)*D(HML(-2)) + C(6)*D(MRP(-1)) + C(7)*D(MRP(-2)) +C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(WML(-1)) + C(11)*D(WML(-2)) + C(12)				
Observations: 93				
R-squared	0.529304	Mean dependent var		-0.001347
Adjusted R-squared	0.465382	S.D. dependent var		0.059423
S.E. of regression	0.043449	Sum squared resid		0.152913
Durbin-Watson stat	2.283624			

The regression results from the Tables 5.6.7., 5.6.8., and 5.6.9. are for the structural break from the period 2009 to 2016. The results show that the four-factor model captures much of the variation in sector returns with the R-Squared for the FINI Top 15 index the lowest at 0.5293 followed by the RESI Top 10 index at 0.5752. The R-Squared for the INDI Top 25 is the highest at 0.5809.

The RESI Top 10 results are presented in Table 5.6.7. The SMB Lag 1, C(4) and SMB Lag 2, C(5) coefficients are -0.2663 and -0.3582 and are statistically insignificant. This suggests a negative coefficient of SMB suggests a large-cap bias. The WML risk factor in C(6) and C(7) are positively and negatively insignificant. The MRP risk factors in C(8) is positively insignificant and C(9)is negatively insignificant. The HML Lag 1 and Lag 2 risk factors are both positively insignificant suggesting growth bias.

The industrial sector index in Table 5.6.8 present the HML Lag 1 in C(4) is positively insignificant with a coefficient of 0.1671. The HML Lag 2, C(5), the coefficient is 0.3102 and is statistically significant.

The MRP risk factors Lag 1 and Lag2 coefficients are -0.0053 and -0.0477 and are statistically insignificant. The SMB risk factors in C(8) and C(9) coefficients are -0.5232 and -0.3121 and are statistically significant. The WML risk factors are positively insignificant suggesting a contrarian bias at a 6-month-mom-period. The speed of adjustment monthly value is -0.001324. This implies that any structural changes in the parameters would mean 1.59% shift towards the equilibrium within the year.

The results in Table 5.6.9 show the FINI Top 15 index on the four-factor model. The coefficients in C(4) and C(5) represent the HML Lag 1 and Lag 2. The HML Lag 1 coefficient is 0.1525 and is insignificant. The HML Lag 2 coefficient is 0.3909 and is statistically significant. The MRP Lag 1 and Lag 2 risk factors in C(6) and C(7) are both negatively insignificant. This suggests the lack thereof of a single factor in explaining risk alone. The SMB risk factor Lag 1 coefficient is -0.2976 and the Lag 2 coefficient is -0.1695. Both these SMB risk factors are statistical insignificant suggesting some large-cap bias. The C(10) and C(11) represent the WML risk factor. The WML Lag 1 coefficient is 0.3823 and is statistically significant suggesting that a 6-month period has a momentum bias. On the other hand, the WML Lag 2 is positively insignificant. The speed of adjustment value is -0.000769 monthly. This implies that any structural changes in the parameters would mean 0.9228% shift back to the equilibrium within the year.

Table 5.6. 10: Summary of market anomalies present in the Four-Factor model

	RESI Top 10			**INDI Top 25**			**FINI Top 15**		
	2000 – 2016	2000 – 2008	2009 – 2016	2000 – 2016	2000 – 2008	2009 – 2016	2000 – 2016	2000 – 2008	2009 – 2016
MRP	N/A	N/A	N/A	N/A	N/A	N/A	Neg market risk*	Neg market risk*	N/A
HML	Mild growth bias	Growth	Mild value bias	N/A	Moderate growth bias	Mild value bias	Value bias*	Value bias*	value bias*
SMB	Small cap bias*	Small cap bias*	Mild large cap bias	Small cap bias*	Small cap bias*	Large cap bias*	small cap bias*	small cap bias*	large cap bias*
WML	Contrarian bias*	Contrarian bias*	n/a	Mild contrarian bias	Moderate contrarian bias	Momentum	Contrarian bias*	Contrarian bias*	Momentum bias*

Source: Compiled by the author

5.6.4. Discussion of Results based on Literature

Basiewicz & Auret (2010) propose that the three-factor model can be used to explain the value effect, and size effect and find that they persist after adjusting for liquidity. Muller & Ward (2013) states that there was no evidence of small size effect, but there was evidence that shares with larger market capitalization underperformance. This study found the existence largely of small size effect in contradiction, however, this exists largely from 2000 to 2008 in bullish conditions. Large market capitalization exists only from 2009 to 2016 in bearish conditions.

Muller (1999) follows up only to find that both winners and losers have a positive momentum effect but looser momentum quicker than winners. The study by Muller & Ward (2013) endorsed momentum as important because they found the persistent outperformance of momentum style with 3 months and 12-month holding period. Furthermore, van Rensburg, Muller & Ward (2013) conclude beta coefficient as a single risk factor does fully explain security returns on the JSE although this study found only evidence of momentum, not size.

On the presence of momentum effect on securities on the JSE Bolton and Von Boetticher (2015) find no evidence of the momentum effect was observed on the ALSI top 40 effect or the reaction after post the global financial crisis. When Boamah (2015) tested the robustness of the CH4FM and the FF3FM, it was found that in the South African equity market there is the existing of size, value, and momentum anomalies. Thus, small size effects as per this study and value (high – low BM firms) shown in this study. This also highlighted there was evidence of past winners outperforming past losers aside from the small-firm group. This is slightly different from this study where contrarian bias is largely in existence. It can be derived that the CH4FM partially captures momentum effects which the Fama and French Three factor fails to capture. It can be stated that the CH4FM only partially capture value in the industrial and resources sector.

This study shows that in majoring of the sectors from 2009 to 2016 the stocks which have underperformed over the past 6 months tend to continue losing for the next 6 months. From 2009 to 2015, there is evidence that stocks which have outperformed over the past 6 months tend to continue winning for the next 6 months in the industrial and financial sectors.

5.7. Fama and French Five-Factor Model

The inability of a single factor model to explain all style-based risk factors that explain returns fully, as they are not captured. This led the variations in a multifactor models some researchers and asset pricing manager have proven to be good. Novy-Marx (2013) implies the FF3-factor model is an incomplete model for expected returns, and that the three factors miss much variation in expected returns. A more advanced asset-pricing model that incorporates profitability and investment effects were developed by Fama and French (2014). This model has been criticized by some researchers for not including the momentum effect as it has proven to be a strong factor in explaining returns. The FF5FM is an enhancement of their world-renowned FF3FM (1993). The model as described in Chapter 4 of this study uses monthly price data, annual balance sheet and income statement return to calculate the variables size, value, operating profitability, and investment factors. This section analyses whether the FF5FM explains the JSE returns better than the FF3FM and the CH4FM. The sub-section that follows presents the descriptive statistics, regression analysis of the FF5FM and the discussion of the results.

5.7.1. Regression Results of the Fama and French Five-Factor model results

The regression results illustrated from Table 5.7.1 to Table 5.7.9 are for the three-sub periods mentioned earlier in Chapter 4. This is to test the applicability of the FF5FM in sectors in a different time period and its ability to predict returns through both the bearish and bullish markets. The periods are the full sample period from 2000 to 2016, the period at the before and including the global financial crisis from 2000 to 2008 and the period post the financial crisis where a recession looms for South Africa from 2009 to 2016.

Table 5.7. 1: FF5FM RESI TOP 10 2000 - 2016

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 1206				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.766040	0.201865	-3.794804	0.0002
C(3)	-0.230066	0.189451	-1.214383	0.2249
C(4)	0.386444	0.443720	0.870919	0.3840
C(5)	0.376808	0.335256	1.123942	0.2613
C(6)	**-0.593968**	**0.358663**	**-1.656059**	**0.0980**
C(7)	-0.152366	0.333405	-0.457000	0.6478
C(8)	0.112049	0.279216	0.401297	0.6883
C(9)	-0.183835	0.252674	-0.727558	0.4670
C(10)	0.221277	0.192590	1.148955	0.2508
C(11)	0.180357	0.192082	0.938962	0.3480
C(12)	-0.114134	0.371435	-0.307280	0.7587
C(13)	-0.286745	0.275632	-1.040318	0.2984
C(14)	**0.000898**	**0.006076**	**0.147748**	**0.8826**
Determinant residual covariance		6.60E-19		
Equation: D(RESI_TOP_10) =C(2)*D(RESI_TOP_10(-1)) + C(3)*D(RESI_TOP_10(-2)) + C(4)*D(HML(-1)) + C(5)*D(HML(-2)) + C(6)*D(CMA(-1)) + C(7)*D(CMA(-2)) + C(8)*D(MRP(-1)) + C(9)*D(MRP(-2)) + C(10)*D(SMB(-1)) +C(11)*D(SMB(-2)) + C(12)*D(RMW(-1)) + C(13)*D(RMW(-2)) +C(14)				
Observations: 201				
R-squared	0.463636	Mean dependent var		-0.000136

Adjusted R-squared	0.426348	S.D. dependent var		0.113666
S.E. of regression	0.086091	Sum squared resid		1.385969
Durbin-Watson stat	2.198772			

Table 5.7. 2: FF5FM INDI TOP 25 2000 - 2016

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 1206				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.432410	0.179892	-2.403717	0.0164
C(3)	-0.293774	0.159374	-1.843297	0.0655
C(4)	-0.143747	0.170669	-0.842257	0.3998
C(5)	-0.075960	0.161009	-0.471772	0.6372
C(6)	0.254707	0.268197	0.949701	0.3425
C(7)	0.203726	0.206179	0.988103	0.3233
C(8)	-0.250130	0.233805	-1.069822	0.2849
C(9)	-0.003206	0.218586	-0.014667	0.9883
C(10)	-0.294198	0.225696	-1.303513	0.1927
C(11)	-0.150248	0.173442	-0.866272	0.3865
C(12)	0.184366	0.121637	1.515710	0.1299
C(13)	**0.261075**	**0.122764**	**2.126646**	**0.0337**
C(14)	**0.000250**	**0.003986**	**0.062806**	**0.9499**
Determinant residual covariance		4.07E-19		
Equation: D(INDI_TOP25) =C(2)*D(INDI_TOP25(-1)) + C(3)*D(INDI_TOP25(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) + C(6)*D(HML(-1)) + C(7)*D(HML(-2)) + C(8)*D(CMA(-1)) + C(9)*D(CMA(-2)) + C(10)*D(RMW(-1)) +C(11)*D(RMW(-2)) + C(12)*D(SMB(-1)) + C(13)*D(SMB(-2)) + C(14)				
Observations: 201				
R-squared	0.393441	Mean dependent var		0.000127
Adjusted R-squared	0.351274	S.D. dependent var		0.070118
S.E. of regression	0.056475	Sum squared resid		0.596430
Durbin-Watson stat	2.250789			

Table 5.7. 3: FF5FM FINI TOP 15 2000 - 2016

Estimation Method: Least Squares				
Sample: 2000M04 2016M12				
Included observations: 201				
Total system (balanced) observations 1206				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	0.280526	0.151555	1.850990	0.0644
C(3)	0.291090	0.110659	2.630522	0.0086
C(4)	**-0.518087**	**0.110326**	**-4.695972**	**0.0000**
C(5)	**-0.413413**	**0.099926**	**-4.137183**	**0.0000**
C(6)	**0.226883**	**0.119732**	**1.894924**	**0.0584**
C(7)	**0.265883**	**0.118716**	**2.239657**	**0.0253**
C(8)	**1.005884**	**0.196467**	**5.119852**	**0.0000**
C(9)	**0.728248**	**0.172157**	**4.230132**	**0.0000**
C(10)	-0.236544	0.150660	-1.570050	0.1167
C(11)	-0.181162	0.148837	-1.217189	0.2238
C(12)	**-0.596331**	**0.216568**	**-2.753549**	**0.0060**
C(13)	**-0.352238**	**0.209979**	**-1.677494**	**0.0937**
C(14)	**0.000153**	**0.003815**	**0.040236**	**0.9679**
Determinant residual covariance		8.67E-19		
Equation: D(FINI_TOP_15) =C(2)*D(FINI_TOP_15(-1)) + C(3)*D(FINI_TOP_15(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) +C(6)*D(SMB(-1)) + C(7)*D(SMB(-2)) + C(8)*D(HML(-1)) + C(9)*D(HML(-2)) + C(10)*D(RMW(-1)) + C(11)*D(RMW(-2)) + C(12)*D(CMA(-1)) + C(13)*D(CMA(-2)) + C(14)				
Observations: 201				
R-squared	0.471701	Mean dependent var		-8.87E-05
Adjusted R-squared	0.434974	S.D. dependent var		0.071923

S.E. of regression	0.054063	Sum squared resid		0.546568
Durbin-Watson stat	2.201211			

The regression results of the Fama and French (2014, 2015) five-factor model are presented in Table 5.7.1. to Table 5.7.9. The results show from Table 5.7.1., 5.7 and 5.7.3 are from the full sample from 2000 to 2016. These results show that the five-factor model captures much of the variation in sector returns with the R-Squared for the FINI Top 15 index the highest at 0.4717 followed by the RESI Top 10 index at 0.4636. The R-Squared at 0.3934 for the INDI Top 25 index is the lowest.

In Table 5.7.1 the RESI Top 10 results for the Fama and French five factors are presented. The MRP Lag 1 and Lag 2 risk factors in C(8) and C(9) are positive and negatively insignificant. The HML risk factors in C(4) and C(5) are both positively insignificant suggesting some growth bias. The SMB risk factors for Lag 1 and Lag 2 are 0.2213 and 0.1803 and both are statistically insignificant. C(6) and C(7) present the CMA Lag 1 and Lag 2 whose coefficients are both negatively insignificant. Lastly, the fifth factor, RMW, coefficients for Lag 1 and Lag 2 are -0.1141 and -0.2867. Both the RMW risk factors are negatively insignificant. The speed of adjustment shown as C(14) represents the monthly coefficient as 0.000898. This implies that any structural changes in the parameters would mean 1.08% shift away from the equilibrium within the year.

Table 5.7.2 represents the five-factor model for the INDI Top 25 for the full sample period. Firstly, the MRP risk factor is negatively insignificant. The SMB Lag 1 coefficient is 0.6843 and Lag 2 coefficient is 0.6254. Bothe the SMB risk factors are statistically significant implying that for the full period from 2000 to 2016 the industrial sector has small-cap bias. The HML risk factors are both negatively insignificant suggesting a mild growth bias. The industrial index's RMW risk factors Lag 1 and Lag 2 coefficients are -0.5347 and -0.1711 and are statistically insignificant. The CMA Lag 1 and Lag 2 risk factors in C(12) and C(13) are both negatively insignificant. The C(14) for the speed of adjustment value is 0.00487 monthly and 0.58% annually. This implies that any structural changes in the parameters would mean 0.58% shift away from the equilibrium within the year.

The financial sector MRP risk factor coefficients are -0.5181 and -0.4134 with a statistical significance of 0.00. The SMB risk factor Lag 1, and Lag 2 coefficients are 0.2269 and 0.2659 with probability values at 0.0584 and 0.0253. This implies a small-cap bias in the financial sector between 2000 and 2016. The HML Lag 1 and Lag 2 coefficients are 1.0059 and 0.7282 and are statistically significant at 0.00. This implies the financial sector has a value bias. The RMW Lag 1 and Lag 2 in C(10) and C(6) are both positively insignificant. The fifth risk factor, CMA, Lag 1 coefficient is -0.5963 and is statistically significant at 1% level. The CMA Lag 2 is -0.3522 and is significant at a 10% level, however, for this study is insignificant. The speed of adjustment is positive at 0.000153 monthly. This implies that any structural changes in the parameters would mean 0.1836% shift back to the equilibrium within the year**.**

5.7.2. Structural Break: 2000 -2008

Table 5.7. 4: FF5FM RESI TOP 10 2000 - 2008

Estimation Method: Least Squares				
Sample: 2000M04 2008M12				
Included observations: 105				
Total system (balanced) observations 630				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.797934	0.384670	-2.074336	0.0385
C(3)	-0.333991	0.338093	-0.987867	0.3237
C(4)	-0.211559	0.505730	-0.418323	0.6759
C(5)	-0.008807	0.368612	-0.023892	0.9809
C(6)	**0.687716**	**0.318416**	**2.159801**	**0.0312**
C(7)	0.336609	0.316781	1.062589	0.2884
C(8)	0.290316	0.485321	0.598194	0.5500
C(9)	0.047244	0.429098	0.110101	0.9124
C(10)	0.166881	0.778344	0.214405	0.8303
C(11)	0.202639	0.541224	0.374408	0.7082

C(12)	-0.546076	0.566329	-0.964237	0.3354
C(13)	-0.416410	0.510749	-0.815292	0.4153
C(14)	**0.000534**	**0.009275**	**0.057551**	**0.9541**
Determinant residual covariance		6.41E-19		
Equation: D(RESI_TOP_10) = C(2)*D(RESI_TOP_10(-1)) + C(3)*D(RESI_TOP_10(-2)) + C(4)*D(RMW(-1)) + C(5)*D(RMW(-2)) + C(6)*D(SMB(-1)) + C(7)*D(SMB(-2)) + C(8)*D(MRP(-1)) + C(9)*D(MRP(-2)) + C(10)*D(HML(-1)) + C(11)*D(HML(-2)) + C(12)*D(CMA(-1)) + C(13)*D(CMA(-2)) + C(14)				
Observations: 105				
R-squared	0.449595	Mean dependent var		-0.000292
Adjusted R-squared	0.370965	S.D. dependent var		0.119588
S.E. of regression	0.094847	Sum squared resid		0.818636
Durbin-Watson stat	2.112767			

Table 5.7. 5: FF5FM INDI TOP 25 2000 - 2008

Estimation Method: Least Squares				
Sample: 2000M04 2008M12				
Included observations: 105				
Total system (balanced) observations 630				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.295357	0.262791	-1.123923	0.2615
C(3)	-0.142709	0.225873	-0.631811	0.5278
C(4)	-0.244984	0.265112	-0.924079	0.3559
C(5)	-0.111025	0.235955	-0.470536	0.6382
C(6)	**-0.534729**	**0.333852**	**-1.601696**	**0.1098**
C(7)	-0.171151	0.246688	-0.693797	0.4881
C(8)	**0.684300**	**0.211116**	**3.241338**	**0.0013**
C(9)	**0.625384**	**0.207297**	**3.016850**	**0.0027**
C(10)	0.426727	0.508382	0.839382	0.4016
C(11)	0.189427	0.352479	0.537414	0.5912
C(12)	-0.426742	0.382349	-1.116106	0.2649
C(13)	-0.255152	0.338673	-0.753389	0.4515
C(14)	**0.000487**	**0.006159**	**0.079114**	**0.9370**
Determinant residual covariance		6.70E-19		
Equation: D(INDI_TOP25) =C(2)*D(INDI_TOP25(-1)) + C(3)*D(INDI_TOP25(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) + C(6)*D(RMW(-1)) + C(7)*D(RMW(-2)) + C(8)*D(SMB(-1)) + C(9)*D(SMB(-2)) + C(10)*D(HML(-1)) + C(11)*D(HML(-2)) + C(12)*D(CMA(-1)) + C(13)*D(CMA(-2)) + C(14)				
Observations: 105				
R-squared	0.427753	Mean dependent var		0.000601
Adjusted R-squared	0.346003	S.D. dependent var		0.077843
S.E. of regression	0.062952	Sum squared resid		0.360623
Durbin-Watson stat	2.214852			

Table 5.7. 6: FF5FM FINI TOP 15 2000 - 2008

Estimation Method: Least Squares				
Sample: 2000M04 2008M12				
Included observations: 105				
Total system (balanced) observations 630				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	0.577987	0.239984	2.408440	0.0164
C(3)	0.380477	0.174026	2.186322	0.0292
C(4)	-0.323293	0.318397	-1.015374	0.3104
C(5)	-0.208692	0.308900	-0.675598	0.4996
C(6)	**0.994620**	**0.306681**	**3.243172**	**0.0013**
C(7)	**0.518323**	**0.277155**	**1.870155**	**0.0620**
C(8)	**-0.878151**	**0.198849**	**-4.416165**	**0.0000**
C(9)	**-0.462238**	**0.159608**	**-2.896084**	**0.0039**
C(10)	-0.073804	0.209244	-0.352717	0.7244
C(11)	-0.094299	0.209127	-0.450918	0.6522
C(12)	0.115230	0.212677	0.541806	0.5882
C(13)	**0.396644**	**0.211848**	**1.872307**	**0.0617**
C(14)	**-7.45E-05**	**0.005763**	**-0.012933**	**0.9897**

Determinant residual covariance		1.29E-18		
Equation: D(FINI_TOP_15) =C(2)*D(FINI_TOP_15(-1)) + C(3)*D(FINI_TOP_15(-2)) + C(4)*D(CMA(-1)) + C(5)*D(CMA(-2)) + C(6)*D(HML(-1)) + C(7)*D(HML(-2)) + C(8)*D(MRP(-1)) + C(9)*D(MRP(-2)) + C(10)*D(RMW(-1)) + C(11)*D(RMW(-2)) + C(12)*D(SMB(-1)) + C(13)*D(SMB(-2)) + C(14)				
Observations: 105				
R-squared	0.505393	Mean dependent var		-0.000436
Adjusted R-squared	0.434734	S.D. dependent var		0.078483
S.E. of regression	0.059007	Sum squared resid		0.316842
Durbin-Watson stat	2.150892			

The results from the Tables 5.7.4., 5.7.5 and 5.7.6 are from the period 2000 to 2008 which is before and at the start of the 2008 global financial crisis. These results show that some variation in the five-factor model is explained by the R-Squared of the FINI Top 15 index which is the highest at 0.5054 followed by the RESI Top 10 index at 0.4496. The R-Squared for the INDI Top 25 index is the lowest at 0.4277.

The RESI_TOP_10 five-factor model results from 2000 to 2008 are presented in Table 5.7.4. The RMW risk factor in C(4) and C(5) coefficients are -0.2115 and -0.0088. This risk factor is negatively insignificant. The SMB Lag 1 and Lag 2 coefficients are 0.6877 and 0.3366. The SMB Lag 1 is positively significant and SMB Lag 2 is negatively significant. The RESI MRP risk factors Lag 1, C(8), and Lag 2, C(9, are positively insignificant. The HML coefficients are 0.1669 and 0.2026, and both are positively insignificant. The CMA risk factor is negatively insignificant. The speed of adjustment for the resources sector is 0.000534. This implies that any structural changes in the parameters would mean 0.64% shifts away from the equilibrium within the year.

Table 5.7.5 present the INDI Top 25 five-factor model results. The MRP Lag 1 and Lag 2 coefficient are -0.2449 and -0.1110 and are both negatively insignificant. The SMB risk factors for Lag 1 and Lag 2 coefficients are 0.6843 and 0.6254. The SMB Factors are both statically significant suggesting from 2000 to 2008 the industrial sector had a small-cap bias. C(10) and C(11) represent the HML risk factor Lag 1 and Lag 2 and are both positively insignificant. The RMW Lag 1 and Lag 2 in C(6) and C(7) coefficients are -0.5347 and -0.1711. RMW risk factors are negatively insignificant. The CMA coefficients in C(12) and C(13) coefficients have -0.4267 and -0.2551, both are negatively insignificant. The speed of adjustment results in C(14) is 0.58% annually. This implies that any structural changes in the parameters would mean 0.58% shift away from the equilibrium within the year.

The 2000 to 2008 FINI Top 15 results for the FF5FM are presented in Table 5.7.6. The CMA risk factors coefficients are -0.3233 and -0.2087 for Lag 1 and Lag 2 as shown in C(4) and C(5). The CMA risk factors are both statistically insignificant. The C(10) and C(10) are Lag 1 and Lag 2 for the RMW risk factor. The coefficients for the RMW are -0.0738 and -0.0943 and are both negatively insignificant. The HML risk factor coefficients are Lag 1 0.9946 and Lag 2 0.5183. Thus, for the Lag 1 HML is positively significant, however, Lag 2 is statistically significant at a 10% level which is not considered in this study. The MRP Lag 1 is -0.8781 and the MRP Lag 2 is -0.4622 and are both negatively significant. The SMB has a positive coefficient of 0.1152 and 0.3966 in both Lag 1 and Lag 2. The SMB lag 2 statistically significant at a 10% significance level, but this study considered only a 5%, this, the SMB risk factor is positively insignificant implying mild large cape bias. The speed of adjustment is -7.45E-05, this implies that any structural changes in the parameters would mean a shift back to the equilibrium within the year.

5.7.3. Structural Break: 2009-2016

Table 5.7. 7: FF5FM RESI TOP 10 2009 - 2016

Estimation Method: Least Squares				
Sample: 2009M04 2016M12				
Included observations: 93				
Total system (balanced) observations 558				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.703024	0.424393	-1.656539	0.0983
C(3)	-0.348041	0.283902	-1.225922	0.2208
C(4)	-0.292175	0.542763	-0.538310	0.5906

C(5)	-0.099623	0.369249	-0.269800	0.7874
C(6)	0.245925	0.547716	0.449002	0.6536
C(7)	0.603887	0.406027	1.487309	0.1376
C(8)	-0.068484	0.605926	-0.113024	0.9101
C(9)	0.048168	0.472517	0.101940	0.9188
C(10)	-0.437152	0.552915	-0.790631	0.4296
C(11)	-0.637692	0.451426	-1.412617	0.1584
C(12)	0.152929	0.484547	0.315613	0.7524
C(13)	-0.113326	0.319583	-0.354605	0.7230
C(14)	**0.000116**	**0.007661**	**0.015130**	**0.9879**
Determinant residual covariance		3.67E-20		
Equation: D(RESI_TOP_10) =C(2)*D(RESI_TOP_10(-1)) + C(3)*D(RESI_TOP_10(-2)) + C(4)*D(MRP(-1)) + C(5)*D(MRP(-2)) + C(6)*D(HML(-1)) + C(7)*D(HML(-2)) + C(8)*D(CMA(-1)) + C(9)*D(CMA(-2)) + C(10)*D(RMW(-1)) +C(11)*D(RMW(-2)) + C(12)*D(SMB(-1)) + C(13)*D(SMB(-2)) +C(14)				
Observations: 93				
R-squared	0.584897	Mean dependent var		-0.001567
Adjusted R-squared	0.516589	S.D. dependent var		0.105825
S.E. of regression	0.073578	Sum squared resid		0.427679
Durbin-Watson stat	2.164351			

Table 5.7. 8: FF5FM INDI TOP 25 2009 - 2016

Estimation Method: Least Squares				
Sample: 2009M04 2016M12				
Included observations: 93				
Total system (balanced) observations 558				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.850031	0.347925	-2.443144	0.0149
C(3)	-0.489081	0.285269	-1.714452	0.0871
C(4)	0.083508	0.214529	0.389262	0.6973
C(5)	0.179520	0.201926	0.889041	0.3744
C(6)	-0.212269	0.286399	-0.741164	0.4590
C(7)	-0.072397	0.265561	-0.272620	0.7853
C(8)	0.210060	0.382022	0.549864	0.5827
C(9)	0.155852	0.303588	0.513369	0.6079
C(10)	-0.217151	0.365971	-0.593356	0.5532
C(11)	0.107782	0.259693	0.415036	0.6783
C(12)	**-0.259985**	**0.174360**	**-1.491083**	**0.1366**
C(13)	**-0.260176**	**0.156831**	**-1.658957**	**0.0978**
C(14)	**-0.000743**	**0.004334**	**-0.171409**	**0.8640**
Determinant residual covariance		1.14E-20		
Equation: D(INDI_TOP25) = C(2)*D(INDI_TOP25(-1)) + C(3)*D(INDI_TOP25(-2)) + C(4)*D(HML(-1)) + C(5)*D(HML(-2)) + C(6)*D(CMA(-1)) + C(7)*D(CMA(-2)) + C(8)*D(MRP(-1)) + C(9)*D(MRP(-2)) + C(10)*D(RMW(-1)) + C(11)*D(RMW(-2)) + C(12)*D(SMB(-1)) + C(13)*D(SMB(-2)) + C(14)				
Observations: 93				
R-squared	0.556492	Mean dependent var		-0.000692
Adjusted R-squared	0.483509	S.D. dependent var		0.057952
S.E. of regression	0.041648	Sum squared resid		0.137031
Durbin-Watson stat	2.194395			

Table 5.7. 9: FF5FM FINI TOP 15 2009 - 2016

Estimation Method: Least Squares				
Sample: 2009M04 2016M12				
Included observations: 93				
Total system (balanced) observations 558				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	-0.235270	0.203113	-1.158319	0.2473
C(3)	0.037113	0.153486	0.241801	0.8090
C(4)	**-0.584654**	**0.364163**	**-1.605476**	**0.1091**
C(5)	**-0.949369**	**0.301181**	**-3.152151**	**0.0017**
C(6)	**0.629801**	**0.306881**	**2.052267**	**0.0407**
C(7)	**1.035046**	**0.233472**	**4.433285**	**0.0000**
C(8)	**-0.326218**	**0.152364**	**-2.141045**	**0.0328**
C(9)	**-0.242978**	**0.145487**	**-1.670104**	**0.0956**

C(10)	**-0.382583**	**0.287639**	**-1.330077**	**0.1841**
C(11)	-0.165016	0.246900	-0.668351	0.5042
C(12)	-0.087411	0.148199	-0.589823	0.5556
C(13)	-0.206935	0.150083	-1.378809	0.1686
C(14)	**-0.000675**	**0.004414**	**-0.152944**	**0.8785**
Determinant residual covariance		3.68E-20		
Equation: D(FINI_TOP_15) =C(2)*D(FINI_TOP_15(-1)) + C(3)*D(FINI_TOP_15(-2)) + C(4)*D(CMA(-1)) + C(5)*D(CMA(-2)) + C(6)*D(HML(-1)) + C(7)*D(HML(-2)) + C(8)*D(MRP(-1)) + C(9)*D(MRP(-2)) + C(10)*D(RMW(-1)) + C(11)*D(RMW(-2)) + C(12)*D(SMB(-1)) + C(13)*D(SMB(-2)) + C(14)				
Observations: 93				
R-squared	0.562015	Mean dependent var		-0.001347
Adjusted R-squared	0.489941	S.D. dependent var		0.059423
S.E. of regression	0.042439	Sum squared resid		0.142286
Durbin-Watson stat	2.304901			

Lastly, the R-Squared results of the period post the global financial crisis (2009 – 2016) are presented in Tables 5.7.7., 5.7.8 and 5.7.9. The results show that the five-factor model captures much of the variation in sector returns with the R-Squared for the INDI Top 25 index the lowest at 0.5565 followed by the FINI Top 15 index at 0.5620. The R-Squared for the RESI Top 10 is the highest at 0.5849. The R-Squared of 0.5849 in favour of the RESI Top 10 index is consistent with the sector allocation of the resources sector overweighed in the ALSI index.

The RESI Top 10 five-factor model from 2009 to 2016 are all statistically insignificant but to different levels. The MRP Lag 1 and Lag coefficients are -0.2922 and -0.0996, thus, the risk factor is negatively insignificant. The HML risk factor coefficients are Lag 1 0.2459 and Lag 2 0.6039, and the positive coefficients are positively insignificant. The SMB coefficients are 0.1529 and -0.1133 for Lag 1 and Lag 2, thus, both are statistically insignificant. The CMA risk factor coefficients for Lag 1 and Lag 2 are 0.0685 and 0.0482, respectively. These CMA factors are both negative and positively insignificant. The RMW Lag 1 coefficient is -0.4371 and the RMW Lag 2 coefficient -0.6377, this, negatively insignificant for the RMW coefficient. The speed of adjustment coefficient is 0.000116 monthly. This implies that any structural changes in the parameters would mean 0.14% shift away from the equilibrium within the year.

Regressing the excess returns of the INDI Top 25 index onto the five risk factors, for instance, exhibits a coefficient of 0.0835 and 0.1795 and a probability value of 0.6973 and 0.3744 for the HML risk factors. Thus, to some degree, the sector performance for the industrial sector to some degree has value bias. Similarly, regressing the excess returns of the INDI Top 25 index onto the five risk factors exhibits coefficients 0.2101 and 0.1558 in Lag 1 and Lag 2 for the MRP risk factor and probability values of 0.5827 and 0.6079. The regression results for the SMB, RMW and CMA coefficients with the probability values are CMA Lag 1 and Lag 2 -0.2123 (0.4590) and -0.0724 (0.7853), RMW Lag 1 and Lag 2 -0.2171 (0.5532) and 0.1078 (0.6783), and the SMB Lag 1 and Lag 2 -0.2599 (0.1366) and -0.2602 (0.0978). The speed of adjustment coefficient is -0.000743 monthly. This implies that any structural changes in the parameters would mean 0.89% shift towards the equilibrium within the year.

The regression results CMA risk factor for the FINI Top 15 coefficients for Lag 1 and Lag 2 -0.5846 (0.1091) and -0.9494 (0.0017). CMA Lag 2 is negatively significant. The HML positive coefficients are 0.6298 (0.0407) and 1.0350 (0.0000), thus suggesting for the stocks in the financial sector are value stocks. The RMW and SMB coefficients with the probability values displayed in brackets are Lag 1 -0.3826(0.1841) and Lag 2 -0.1650 (0.5042); and Lag 1 -0.0874 (0.5556) and Lag 2 -0.2069 (0.1686) respectively. The performance of the MRP Lag 1 shows a coefficient of -0.3262 and Lag 2 -0.2429 The Lag 1 is negatively significant, but, Lag 2 has in insignificant suggesting a weak relationship. The speed of adjustment monthly coefficient is -0.000675. This implies that any structural changes in the parameters would mean 0.81% shift back to the equilibrium within the year.

The R-Squared from Table 5.7.1 to Tables 5.7.9 it is evident that Fama and French five-factor model with the assumption of CAPM performs better at capturing return variation on the JSE. Furthermore, for all tests for the FF5FM, Finally, there is no first-order autocorrelation in the regression residuals as indicated by the Durbin Watson stat ranging between 2.1127 and 2.3049, throughout. Regressing the excess returns of each sector index onto the risk factors, the results show that the regression coefficients are statistically insignificant for the majority of the style risk factors. Finally, RMW premiums are not significant at the 10 percent significance level suggesting that these premiums do not help explain returns on the JSE. Kubota and Takehara (2017) conclude in their study that the original version of the Fama and French five-factor model is not the best benchmark pricing model for Japanese data during our sampling period from the year 1978 to the year 2014. In the South African context Mahlophe, (2015) found that that the FF5FM was applicable to the JSE and the value anomaly may lose its predictive power when profitability and investment are included in the model. This study showed that there is no standard asset pricing model that outperforms other asset pricing models for this particular study. These results in this study are consistent with that there is no single best asset pricing as shown by the R-squared results. The highest R-squared for the FF5M in the RESI Top 10 index from 2009 to 2018 at 58.49% which is not enough to determine with no doubt that the cross-section variance of expected returns for the size, value, profitability and investment portfolios are explained fully by the FF5FM.

The findings from Du-Pisanie (2019) show that the five-factor model provided the best explanation of share behaviour on the JSE out of all models evaluated. Other findings included: the CAPM does not work well as an explanatory model, more factors in an asset pricing model generally give better results and the results from models with the same number of factors are fairly close together. The study made use of the Excel VBA code differing with requirements of each factor and portfolio sorts, thus differing from this study.

Table 5.7. 10: Summary of market anomalies present in the Five-factor model

	RESI Top 10			**INDI Top 25**			**FINI Top 15**		
	2000 – 2016	2000 – 2008	2009 – 2016	2000 – 2016	2000 – 2008	2009 – 2016	2000 – 2016	2000 – 2008	2009 – 2016
MRP	N/A	N/A	N/A	N/A	N/A	N/A	Neg market risk*	Neg market risk*	Neg market risk*
HML	Mild value bias	Mild value bias	Mild value bias	Mild value bias	Mild Value bias	Mild value bias	Mild value bias	Value bias*	Value bias*
SMB	Mild small cap bias	Mild small cap bias	N/A	Small cap bias*	Small cap bias*	Mild large cap bias	Small cap bias*	Mild small cap bias	Mild large cap bias
RMW	Mild Weak operating profitability	Mild Weak operating profitability	Mild Weak operating profitability	Mild Weak operating profitability	Mild Weak operating profitability	N/A	Mild Weak operating profitability	Mild Weak operating profitability	Mild Weak operating profitability
CMA	Mild aggressive investing	Mild aggressive investing	N/A	Mild aggressive investing	Mild aggressive investing	Mild aggressive investing	Aggressive investing*	Mild aggressive investing	Aggressive investing*

Source: Compiled by the author

The results are shown in Table 5.6.10. show that the value bias is statistically significant in the financial sector and in all the sectors through the periods remain mildly present. This means that value does not become redundant in this study with the addition of the operating profitability and the investing factors. The operating profitability's results are all statistically negatively insignificant, despite; the results allude to a weak operating profitability bias in all the sectors through the three periods. The financial sector in the full sample period and from 2009 to 2016 display an aggressive investing bias. This is the only sector in which it is significant. The small-cap bias is present in the industrial sector in the full sample period and from 2000 to 2008, and in the full sample period for the financial sector. From 2009 to 2016, there is a mild large-cap bias in the industrial and financial sector.

5.7.4. Discussion of Results based on Literature

In a research study by Mahlophe, (2015) it is shown that the Fama and French Five factor model (2014) is able to account for expected returns on the JSE. This also revealed that the value anomaly loses its predictive power when profitability and investment variables are included in the model. However, in this study's results presents shows that value factor partially presents in all the sectors except in the financial sector where value remains statistically significant throughout the bearish and bullish market conditions. The five-factor model has yet to be proven as an improvement compared to previous models. However, it has left room for better models to be further developed from it in the future.

As shown in Table 5.7.10, there are signs of partial existence of the weak operating profitability stocks, while there are mild aggressive stocks in all sectors except the financial sectors. The research study by (Mahlophe, 2015) further shows that RMW and CMA premiums are not significant at the 10 percent significance level suggesting that these premiums do not help explain returns on the JSE. These results are consistent with this study except for the financial sector. The financial sector suggests that firms in this sector are aggressively directing profits towards major growth projects are likely to experience losses in the stock market.

5.8. Overview of the Asset Pricing Model Findings

The results when comparing the multifactor assets pricing models together over the period between 2000 and 2016 show that the financial sector has the majority of the style risk factors prevailing as more variables are inputted. When using the FF3FM the HML it is negatively significant for the resources sectors and HML is positively significant at 1% in the financial sectors. The resources sector shows some presence of growth anomalies while the financial sector has value style-risk factor. Furthermore, using the FF3FM there is positive statistical significance in all the three sectors for the SMB however, this is at different degrees of significance. When the CH4FM is implemented, the resources sector show significance levels are present on the HML (negative at 1%), the SMB (positive at 5%) and the WML (negative at a 5% level). Whereas using the same model for the in the industrial sectors is only significant at 5% for the size style risk factor. In the financial sector all the variables are statistically significant at a 5% level of significance. Lastly, when the FF5FM is implemented thee is a statistical significance at 10% level for the CMA in the resources sector as the value factor disappears. The FF5FM results in the industrial sector show a significance level at 5% in the SMB. The financial sector seems to have the majority of the style-based risk factors as they the SMB is positively significant at 5% level, the HML is significant at a 1% level and the CMA is negatively significant at a 10% level of significance.

The results presented in this chapter show that all asset pricing models for all sectors tend to perform better from the period 2009 to 2016 as shown by the CH4FM and FF5FM. The R-Squared post-2008 where the bullish market begins to pick up showing that adding on more factor gives better explaining capabilities for the return. Secondly, it is evident that the three major sectors of the JSE analysed in this study are not efficiently indicated by the EMH. This implies that the AMH may have some relevancy which is an area that needs further investigation in the South African market. This is due to the differing value, size, momentum 6-month holding period, operating profitability and investment risk factors across the sectors and the time period. The lack of substantial evidence on the operating profitability of the FF5FM raises the question of its validity and relevance. These style risk factors are subjective to eh different sectors and asset pricing models.

It is evident that from 2000 to 2008 small-cap bias, contrarian bias, value bias and growth bias (only in the resources sector) are present. Additionally, post the 2008 crisis when the market was recovering these anomalies were present value, size, aggressive investing and momentum (both winner and loser). The presence of these style-based risk factors differs across sectors and is affected by different asset pricing models. Thus, it can be determined that for the resources, industrials and financial sectors the unrestricted risk-free rate used in the FF3FM, CH4FM and the FF5FM captures more variation in returns as established by this study. Moreover, the outcome of this study that the multifactor asset pricing models capture better the effected style-based risk factors, are mixed, in as in some sectors especially industrial sector the CAPM performs better and I majority of the sectors the multi-risk factor models examined performed better.

The results presented of the applicability of the Fama and French Five-Factor model on the resources, industrial, and financial sectors are compared to the Carhart Four Factor model over the same three-period, 2000 – 2016, 2000 – 2008 and 2009 – 2016. It is evident from the results that the CH4FM with a 6-month holding period performs better than the FF5FM for the resources and industrials sectors. The financial sector seems to withstand both models and leaning better performance on the FF5FM. The three asset pricing models tested in this study capture the effects of the market anomalies, and the CH4FM performs better at it throughout. Furthermore, it is also unmistakable that the value anomaly loses its predictive power in all sectors except the financial sector when RMW and CMA variables are included in the model.

All in all, the results are shown in this study are suggestive that there is still no agreement on which asset pricing model is best at pricing assets and explaining the risk and returns on the JSE; however, the results established in this chapter indicate that the more the style-based risk factors the better the performance of the models. In conclusion, market anomalies are present on the overall JSE and in the individual sectors on the JSE.

The time-series regressions using the Fama and French (1993), the Carhart (1997) four-factor model and Fama and French (2014) five-factor model vary marginally in how they capture sector returns with the FINI Top 15 index and the RESI Top 10 index accounting for the highest R-squared respectively. The regressions from 2009 to 2019, for both the CH4FM and the FF5FM, seem to replicate the sector return better than the prior period. The MRP risk factor substantiated statistically high probability values for each sector index when the CAPM is tested alone. When more factors are added its significant levels are reduced. In the financial sector for the multifactor models, it becomes negatively significant.

Regressing the excess returns of resources, industrials and financial indices against the risk factors, the results show that the regression coefficients are statistically insignificant for the majority of the style risk factors. Despite the statistical insignificance of the coefficients, a certain degree of insight could be inferred from the magnitude of the probability value results. Although the regression results for the three-sector indices exhibit negative coefficients and show weak sensitivities to the RMW risk factor, the results suggest that the sector performance to some degree have weak operating profitability bias. The same came to be implied on the CMA risk factor on the RESI Top 10 and the INDI Top 25 which suggest some degree of aggressive investing bias in both sectors. The financial sector shows a strong sensitivity to the CMA risk factor.

The WML risk factor, for the most part, provides moderate sensitivities to each of the sectors. Majority of WML coefficients suggests a factor suggests a contrarian bias for all the three sectors at time periods. The WML coefficients from 2009 to 2016 for the FINI Top 10 suggest this sector has momentum bias while the INDI Top 25 shows to some degree the presence of mild momentum bias.

When using the FF3FM the negative and significant coefficient suggest that growth bias exists on the JSE sector returns for the full sample period. When the CH4FM and FF5FM regression results are observed it is noted that value bias exists especially on the FINI Top 10 index. Lastly, in the three-sector returns they exhibit positive coefficients and show the strong sensitivities to the SMB risk factor, the results suggest that sector performance for all sectors to a degree have a small-cap bias. The large-cap bias is observed in the industrial and financial sector from 2009 to 2016.

5.9. Chapter Summary

This chapter presented and discussed the empirical results found in the study. The aim of this chapter was to determine the effects of size, vale 6-month momentum, profitability and investment style-based risks have on the resources, industrial and financial sector returns of the JSE. This chapter further examined the applicability of the FF5FM (2015) on the JSE sectors and it compared the multifactor models against the CAPM to derive which better explain returns over different time periods.

This chapter aimed at addressing the following empirical objectives:

- To determine the predictive ability of the CAPM in explaining the performance of securities on the JSE before and after the global financial crisis.

- To determine the influence stock anomalies, have on the performance of securities on the JSE over the examination period, by using the Fama & French Three-Factor Model; Carhart Four-Factor Model and Fama & French Five-Factor Models. We examined, which asset pricing model between the FF3FM, CH4FMand FF5FM best explains expected returns given the different levels of risk and systematic factors included in the resources, industrials and financial sectors of the JSE.

This chapter started with a discussion of the stationarity and cointegration test results. These showed there is a long-run relationship between the variables based on the results of cointegration using the trace and eigenvalues. The second section of this chapter analysed the results of the cross-sector analysis where monthly stock returns were analysed.

The chapter began by discussing the results of the cross-sector analysis, where monthly stock returns were analysed to determine the effects of market anomalies across sectors of the JSE. This was accomplished by using different asset pricing models, including examining the applicability of the recent Fama and French five-factor model on the JSE. Chapter 6 provides a summarised picture of the main results of this study that supports that style-risks anomalies are present on the JSE.

CHAPTER SIX: SUMMARY AND CONCLUSIONS

6.1. Concluding Remarks

The past decades have been coupled by investors trying to determine whether the market is efficient, and which asset pricing model and market anomalies best explains the return and risk relationship. Moreover, because the CAPM cannot fully explain stork return; much concern has been placed by investors and asset pricing practitioners on establishing which asset pricing model best estimates stock returns as a multiple of them exist. However, this has been a challenge as empirical evidence has shown that patterns in stock return data exist that cannot be explained with classical finance models' additional models fail to capture all risk factors. Several behavioural and rational models have been developed to explain the patterns in stock returns and much still is unexplained in the South African market on these models. This has led to the need for investors to be aware of the effect of market anomalous behaviour on security returns as these market anomalies are said to change with market conditions and tend to differ across sectors.

It is difficult to defend a position on which market anomalies affect the performance of asset returns on the JSE. Many asset pricing models have been derived but they have produced different results in different economies and market conditions. For this reason, an evaluation of sectors and the style anomalies relationship with security performances over time in the South African stock market is essential. Furthermore, the JSE has grown over the past 20 years with much changes in composition, growth, improvements, reclassification, and reclassification, hence, this study chose to focus on three major sectors that have been the most consistent throughout. Thus, the focus was on the resources, industrial and financial sectors. This study chose to investigate the improvements which asset pricing model better explains returns before and after the 2008 global financial crisis. We cannot quickly jump to conclusions that the performance of equities was decreased by the financial crush or that it created opportunities. Implementation of a model requires one to have confidence in which revolves around positive testing of the model. Hence, a review of the past events including the 2008 financial crises is essential. Furthermore, investors seek answers as to whether they should be concerned about the effects these market anomalies have on expected returns.

From an overall perspective it can be seen that, there is extensive research on market anomalies worldwide, but there is no clear-cut approach as to which method is the most appropriate for testing these market anomalies and their effect on expected stock returns, especially when different sectors of the stock market are considered. Thus, a further study on the effect of market anomalies on the expected return across all the JSE sectors and, which asset-pricing models better captures these effects, will shed more light on this topic. Howbeit, the topic of market anomalies tends to be controversial because the presence of market anomalies tends to vary from sample to sample, implying that it is difficult to generalize the effect of market anomalies on stock returns. Additionally, it has been shown that aftermarket anomalies are analysed and documented in academic literature they often disappear, reverse or weaken. It is, therefore, important to conduct a further study on this topic. This will give investors a broader view of different methods, which can be used to estimate expected returns, as no one model has been said to be accurate. Conducting a sector analysis will be indicative as to which market anomalies impact expected return of individual sectors and this would give South African investors a clear picture of which sectors are affected more by the specific market anomalies. Overall, this study will add to the existing body of knowledge on the effect of market anomalies and stock returns in different sectors.

The well-documented anomalies such as the size effect, the value effect, the momentum effect and price reversals have produced significant debate related to the joint hypothesis problem of the efficient market hypothesis (EMH). The well-documented anomalies suggest that asset pricing models based on investor rationality are subject to pricing irregularities and have prompted many observers to argue that the anomalies provide evidence against the EMH.

As has been mentioned in the first chapter, this study aimed at identifying and analysing the effect of style-based risks, market anomalies, on the expected returns across the resources, industrial and financial sectors of the JSE and comparing the performance of the Capital Asset Pricing Model, Fama and French Three-Factor Model, Carhart Four Factor Model and the Fama and French Five-Factor Model, their ability to account for market anomalies in the three major sectors of the JSE. The style based-risk factors observed in this thesis included value by Basu (1977) and size by Banz (1981) and both observed by Fama and French (1993), the momentum effect analysed by Jegadeesh and Titman (1993) and Carhart (1997), and finally the two factors incorporated into the FF5-factor model, known as profitability and investment. All these market anomalies were found to have, to a certain extent, an effect on excess stock returns over the period 2000 to 2016.

6.2. Summary of the Study

The key objective of this study was to examine the effects of market anomalies (style-based risks) on the performance of securities on the resources, industrial and financial sectors of the JSE. In accordance with the primary objectives of the study went on to review theoretical studies on traditional finance i.e. EMH, and Behavioural approach, and empirical studies that investigated the effect of market anomalies on the stock returns in the developed markets and emerging markets, it followed to test the effect of selected market anomalies on expected returns of different sectors of the JSE. They also compared the performance of the different asset pricing models and their ability to account market anomalies of the resources, industrial and financial sectors of the JS, including the applicability of the FF5FM.

Summary of literature review

At the core of the theoretical literature are the arguments brought forward by the EMH and behavioural finance. The EMH believes that the market is rational and that stock prices reflect all available information about the security, therefore assuring that markets are efficient. This has received much criticism for it only accounts for market risk, and not explaining security returns fully. Thus, the behaviours argued on investor irrationality which leads to the overreaction/under reaction in the market. They argue investors are influenced by their emotions which causes share prices to fluctuate beyond their fair value. Thus, to them, the market is not efficient, and they criticize the largely assumptions of the EMH. The arguments between the EMH and behavioural finance led to the development of the AMH can be viewed as a newer version of the Efficient Market Hypothesis (EMH), The AMH states that individuals are piloted by bounded rationality under which they search for a solution that is considered "good enough" as the costs of perfect optimization are constrained (Lo, 2004). This AMH attempts to reconcile market efficiency with behavioural finance by applying principles of evolution, thus, competition, reproduction, and natural selection to social interactions in a socio-biological framework, but much is still to be done on this model. The EMH and behavioural arguments have lead researchers and practitioners to combine psychology and finance in order to establish the reasons behind investor decisions, which lead to the presence of market anomalies.

The empirical studies reviewed in this study indicated that the size effect, value effect momentum effect have been present both on emerging and developed markets, however, there is still limited evidence on the applicability of the Fama and French (2014) model and its comparison to the other asset pricing model. Based on South African literature reviewed, Graham and Uliana (2001) & Bhana (2014) found evidence of the value effect while Robertson and van Rensburg (2002; 2003) found evidence of the size and value effect and Muller and Ward (2013) & la Grange and Krige (2015) found evidence of the momentum effect on the JSE. Majority of these authors followed similar methods fundamental ratios and Fama and French models in their cross-section regressions. However, some found no evidence of these market anomalies such Auret and Cline (2011) found no evidence of the size or value effect and Robertson and van Rensburg (2002; 2003) & Bolton and Boetticher (2015) found no evidence of the momentum effect on the JSE. Through this, it is evident that through the different asset pricing models, and numerous theories, mispricing could lead to irregular patterns in the market, which investors can use to their advantage and obtain abnormal market returns. There has not yet been clear evidence as to what causes the presence of market anomalies, but empirical studies show that market anomalies differ from markets, economies, time periods and in some instances, some of the asset pricing models are unable to account for them. Therefore, testing of style-based anomalies requires the application of different multifactor asset pricing models.

Summary of methodology and main findings

This study made use of the Fama and French three-factor model, the Carhart Four Factor model and the Fama and French Five-Factor model to the effects of the style-based risk factors of the resources, industrials and financial sector returns of the JSE. This was done through the use of monthly observation from 2000 to 2016, with a further split from 2000 to 2008 and 2009 to 2016 for the CH4FM and the FF5FM.

The CAPM served as the foundation of the multifactor asset pricing model used to test its predictive abilities in explaining returns used in this study. Moreover, the risk-free rate was unrestricted in the multifactor asset pricing models, as it is in the CAPM. This is found to be limited in its ability to explain returns lacking ability to capture abnormal returns as the market is found to be inefficient. The coefficients were found to be negatively significant. Of the three-sector indices under examination, the risk and return performance statistics reveal that the FINI Top 15 index is the most consistent performer as it offers the highest risk-adjusted returns. Therefore, this study's results of this research reflect the concept that traditional finance principles may have assumptions that are not representative of the JSE. Regressing the excess returns of each sector index onto the risk factors, the results show that the regression coefficients are statistically insignificant for the majority of the style risk factors. Despite the statistical insignificance of the coefficients, a certain degree of insight could be inferred from the magnitude of the probability value. While academics debate the value of the CAPM, the main question relates to companies that now use it in their capital budgeting process and what should be their locus? This remains unknown. Obviously, capital budgeting decisions were made before there was a CAPM, and they can be made again devoid of it. But the empirical data over the years seem to suggest a steep curve. Regardless of the academic debate, and for those with a longer view, the CAPM still seems to have something to offer.

However, as additional factors are added thus, value and size through the FF3FM, the predictive power over the CAPM is shown be stronger in the financial sector when compared to the resources and the industrial sectors. The financial sector shows the presence of the value and size (small cap) effect, while the resources sector shows some mild growth and size (small cap) effect presence. The industrial sector shows no value effect only some degree of moderate effects of size (small cap) can be inferred. When the CH4FM as analysed the CAPM performed better than the CH4FM in the industrial sector for the 6-month holding period momentum variables from 2000 to 2008, however, post-2008 the CH4FM outperforms. In contrast, the CH4FM performed better than the CAPM in the financial and resources sectors when both 2000 to 2008 and 2009 to 2016 time period were incorporated. It is evident that in the from 2000 to 2008 in the resources sector there are growth, size (small cap) and contrarian effects while in the financial sector there is the presence of value, size (small cap) and contrarian effect. However, the industrial sector there is size (small cap) and it can be inferred there is some mild growth and mild contrarian effect. From the period 2009 to 2009, the financial and industrial sectors show the presence of size (large-cap) and some mild large-cap effects. The financial sectors outperform with values, which can be moderately inferred in the other sectors, similarly applies with the presence of momentum effect which mildly evident in the industrials and the resources have no evidence. Overall, when compares the INDI Top 25 has the highest R-squared followed by the RESI Top 10 and FINI Top 15 at lowest from 2009 to 2016. The model captures anomalies in all sectors mostly in the financial sectors and resources sectors through the periods.

These research results establish that a pattern exists in the results, where results differ across the JSE sectors and are affected by the asset-pricing model used. It can be established that whenever the FF3FM and CH4FM are not restricted, they tend to capture the effects of market anomalies in mostly the resources and financial sectors. Notably, pre-2008 and post-2008 the financial sector remains strong in value effect. The industrial sector returns tend to elude that it is the most efficient sector as the presence of the market anomalies is most inferred as a result of the statistical insignificance, this implying of the three sectors it is the most efficient sector of the JSE and that in this sector investors can only obtain returns equal to the market. It is unmistakable that the financial and sectors the models are able to capture the effects of market anomalies are with the FF3FM and the CH4FM, although the addition of the momentum through the CH4FM makes a better model.

The application of the FF5FM adds operating profitability and investment effect on the value and size effect. The RMW risk factor infers as presence of mild weak operating profitability throughout the three-time period where there is no single sector with statistical significance below 5%. The same applies to the CMA risk factor, however, the financial sectors shows evidence of aggressive investing effect. The FF5FM from 2000 to 2016 only outperforms on the FINI Top 15 and the CH4FM show to the better model for RESI Top 10 index and the INDI Top 25 index. From 2000 to 2008 the FF5FM is a better model when explaining the industrial index and the financial sector, however, the CH4FM stands strong for the resources sector. Lastly, from 2009 to 2016, the CH4FM captures the effects of style-based anomalies better for the INDI Top 25 index than the other two indices, while, FF5FM performs better for the RESI Top 10 and the FINI Top 15, respectively. Overall the results of the application of the FF5FM on the JSE indicate that the FF5FM perform well at capturing the effects of market anomalies on JSE better than the FF3FM. These findings indicate that against the CH4FM the FF5FM performs well but lack to fully explain anomaly effects as the operating profitability and investing factors. Furthermore, the study established that in the resources and industrial sectors the value anomaly may lose its predictive power when profitability and investment variables are included in the model.

The question of whether anomalies can be explained with rational or behavioural explanations remains a vividly debated one. Based on our findings we have to conclude that investors are subject to biases. The Carhart Four Factor models seem to be a better model at explaining the effects of market anomalies.

One other finding that requires further exposition is the speed of adjustment that was insignificant for most of the estimated models but showed signs of returning to equilibrium when there is a shift in the model. This could be as a result of the data set we used or the inherent structure of the South African economy.

6.2.2. Implications for Management

The study attempts to accumulate information that will add to the body of knowledge on the comparison and tests of the multifactor asset pricing models. The FF5FM establishes that the ability of the model to explain stock return on the JSE is limited and it makes the value anomaly redundant in some sectors of the stock market, The FF5FM gives a better understanding of what is driving variation in stock, but, the CH4FM seem to be better as it adds momentum an essential factor in explaining behaviour.

The understanding of how the JSE securities behave differently market conditions is an academic challenge to a great degree. The proposed theories and models used in this study have been developed for the overall 50 years and that has taken great time and effort into developing. However, due to integration, segmentation and different market conditions, these proposed models perform differently. It is clear that a comprehensive and accurate model and understanding of the stock market does not exist. Therefore, this research adds value to the continual development of understanding stock return and risk relationship.

This specific item of research has identified that on the JSE, the five-factor model explains 42 % to 51 % of stock returns and 55% to 59% of Stock fluctuation, bullish and bearish markets respective. This leaves 41% to 57% still to be understood and explained. While this may seem like a long way to go, consider that the traditional asset pricing model (CAPM) leaves 47% to 54% unexplained. The Carhart four factor model leaves between 41% and 61% unexplained. Apart from having much left to be done, some progress has been made with respect to style investing studies. The study finds the existence value, size, and momentum. However, much leave to be explained or different strategies used to explain profitability and investment. For this study, the investment (CMA) is an added key in the financial sector of the JSE which outperforms in bearish market conditions. In addition, the size (small) remains strong and consistent throughout the models coupled with value. This consistent outperformance gives some confidence that size and value can be applied for any time. Outperformance that changes frequently is the opposite and one should be careful of investing in that style like momentum and investing factors.

6.3. Conclusions

The impact of factors affecting stock returns and the determination of the explanatory power of the asset pricing models have become one of the most important and remarkable issues for academics, practitioners, and analysts in the financial world in recent years. In this respect, when studies on the South African market are investigated, it is seen that CAPM, FF3FM, and FF4M are used in explaining the variations in the stock returns. Thus, this study added the FF5FM to the argument and attempted to determine the effects style-based risk factors have on expected returns across the resources, industrial and financial sectors of the JSE. The results from this study show that a number of style-based risk factors are present across the three sectors and that there is a degree of market inefficiency in these sectors. Additionally, the performance of the asset pricing models, CAPM, FF3FM, CH4FM, and FF5FM are compared and their ability to account for market anomalies in different sectors. The results indicate that the presence of market anomalies differ across the sectors and the time periods, and with the change of asset pricing models and their specifications.

Specifically, in a bullish market, there is the presence of size and contrarian in all sector but there is growth in the resources sector while there is value in the financial sectors. Moreover, in a bearish market, the financial sector has the presence of value, momentum and aggressive investing factors, while in all the sectors there is mild presence of large-cap bias, weak operating profitability and aggressive investing. Moreover, the results suggest that the Industrial sector is the most efficient sector of the JSE, thus it would be difficult for investors to obtain above-average returns in this particular sector. Finally, the study showed that the FF5FM model was applicable to the JSE from 2009; however, the value anomaly may lose its predictive power when profitability and investment are included in the model. It is evident that there is no standard asset pricing model that outperforms other asset pricing models for this particular study, however, it was established that when the market conditions start changing the predictive abilities of models also start changing. Overally, this study shows the Carhart Four Factor model is a better model at capturing effects of the market anomalies, especially in the financial sector. In conclusion, it may be worthwhile for researchers to look further into conditional asset pricing models, implying restricting or unrestricting certain variables in the model to determine if more useful results can be obtained.

6.4. Scientific Contribution to Knowledge

From this study, the most significant finding (statistically, educationally and practically) seems to be that investment style risk factors are the best indicator of explain the relationship between risk and return in the South African market. As the South African market continues to grow and become more integrated with the world, it seems the CAPM becomes redundant. The anomalous factors to consider are determined by the sector of the economy, the market sentiments including investment behaviour and the requirements of an individual investor. Although some researchers have shown the CAPM is valid, there is much more value added by the Carhart Four Factor Model and The Fama and French Five factor Model. This investigation no studies have concentrated solely on examining all six factors, market risk, value effect; size effect; momentum effect; profitability effect and investment effect prior to and post the 2008 global financial crisis. The consistency is an evident relationship, if there is one, has not been examined. Furthermore, there is no consensus on the results presented some have found evidence and some do not find any evidence due to varying study data samples.

Therefore, this study examined the major asset pricing models including the recent Fama and French five factor model (2015) comparing the model performance pre- and post-2008. So far most of the studies on the FF5FM have focused on proving that the addition of profitability factor makes value redundant. In this research, the author not only focused on comparing the FF5FM against other asset pricing models and in different market sentiment environments in the South African market. This study dissects the time period between 2000 and 2016 into two periods to determine which anomalies are more present in bearish and bullish markets. In this study, the author tests the applicability of the five-factor model and the reaction of the model to market sentiments. Considering the limited data used in a bullish market there is more significate of growth stock being where the investors need to be focusing on. However, in a bearish market, there is more significance on value stocks and aggressive investing. The two added factors operating profitability and investment are mostly mildly present which questions their validity.

6.5. Limitations of the Study

After the initial data collection, the researcher had insufficient understanding and acceptance of big data. The raw data collected from IRESS was overwhelming and the researcher had only knowledge of using formulas in a textbook context and never practical learning nor application. Therefore, it took the researcher about a year to understand and get a background on how to sort the data, clean and use the appropriate formulas in Excel and E-Views. In addition, it is challenging at first to manage data quality. Furthermore, the application of the Fama and French would have been done better if it had been done soon after data collection with the appropriate software. Nevertheless, the researcher managed to do the analysis with econometric and statistical techniques.

Despite the high ambitions that had been set out at the beginning of this research study, it was constrained, by the lack of both financial and non-financial resources. The difficulties involved in the data collection process were the main obstacle. This led to the reduction of the intended study period limiting it to 17 years. This also led to limiting of the asset pricing theories to the basic modelling and the tests for longer (i.e. 12-month momentum). Limitations of time, funding and scope of the study required the research study to focus on a limited number of objectives. Moreover, the research problem and questions often directly or indirectly involve multiple areas of financial management while limits of time and funds would not allow all areas to be investigated.

Because of limited access to scare resources, this study could not research the first objective in-depth, thus, to examine JSE stock selection and performance effects on market segmentation. Given more time and funds. Because of the limited data collection points, it was difficult to have full access to data with all the required ports available with guidance. The limited access to external guidance made this study longer and most of the results are only from the student’s point of view.

The All Share index consists of over 150 JSE-listed companies and is the largest index in terms of size and overall value, which signifies 99 percent of the total market capitalisation of tradable stock, thus the study may be prone to thin trading as explained in Chapter 4. This implies that the results may be biased in the direction of some companies on the JSE, which may experience infrequent trading.

6.6. Recommendations

In spite of all the limitations, the results presented in this study suggest practical ways for investors to identify which investment risk factors give abnormal returns in bearish and bullish market environments. These investment style risk could assist their portfolios to have better returns in any market conditions.

1. The CAPM produced good results, but it is not a good indicator alone, in line with previous research studies. It is certainly important for investors to consider more factors in asset pricing in portfolio management.
2. The results also show that the Carhart Four Factor model is the best model to use in all market conditions especially in the financial sectors as momentum is an important factor. The need for a model with operating profitably and investing factors showed that value becomes redundant

in a bullish market but vice versa. The Carhart Four Factor Model and the Fama and French Five Factor Model are worth putting effort into using as they give more options for investors to explain the risk and return relationship.

3. This study was unrestricted and only the 6-month holding period was set to test effects on the Carhart four factor model. Thus, most of the models used in this study partially capture value, momentum, profitability and investment effects. The use of the models could be better handled with momentum-sorted portfolios and the asset-pricing models' restrictions to determine whether anomalies would remain evident and to what degree
4. Furthermore, as suggested by Bhana (2014), investor behaviour considerations and agency costs of investment management appear to support the observed value premium. For this study, transaction costs have been ignored relating to the rebalancing of each portfolio on the grounds that these will be approximately the same between portfolios. There needs to be further investigation on the market anomalies couples with agency costs, especially on the Fama and French Five Factor to observe the behaviour of value.
5. For future research, there is the need to investigate in-depth stock selection on the JSE stock selection and performance effects on market segmentation. This will test for the effects of segmentation on the performances on securities in portfolios and identify any sources of the segmentation that are evident. This would make a good base for exploring the style-based risks that are prevalent in the South African market.
6. This study identified that as more style -based risks are added on the value anomaly tends to lose its predictive abilities. Thus, this raising the question if value should be part of the five-factor model. The study did not examine if the Fama and French five-factor model should be a four-factor model or if it should remain a five-factor model, or if a six-factor model that adds momentum will fully explain return and risk, thus this should be examined in the future.

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ANNEXURES

Presented below are the findings of the stationarity tests, cointegration tests and the raw data calculation for the variables.

A. Stationarity Test in Variables

Null Hypothesis: CMA has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.04376	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: FINI_TOP_15 has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.86646	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: HML has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.06093	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: INDI_TOP25 has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.69089	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: MRP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.88926	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: RESI_TOP_10 has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.83038	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: RMW has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.29083	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: SMB has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.15255	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: WML has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.70154	0.0000
Test critical values:	1% level	-3.462574	
	5% level	-2.875608	
	10% level	-2.574346	

*MacKinnon (1996) one-sided p-values.

B. Cointegration Results

Model 1: CAPM results

Table 5.2. 1: RESI Top 10 MRP Cointegration
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: RESI_TOP_10 MRP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.176698	65.27649	15.49471	0.0000
At most 1 *	0.125051	26.58444	3.841466	0.0000

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.176698	38.69206	14.26460	0.0000
At most 1 *	0.125051	26.58444	3.841466	0.0000

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.2. 2: INDI_TOP_25 MRP Cointegration
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: INDI_TOP_25 MRP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.168413	60.73650	15.49471	0.0000
At most 1 *	0.113779	24.03697	3.841466	0.0000

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.168413	36.69953	14.26460	0.0000
At most 1 *	0.113779	24.03697	3.841466	0.0000

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.2. 3: FINI TOP 15 MRP Cointegration
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: FINI_TOP_15 MRP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.240713	86.68545	15.49471	0.0000
At most 1 *	0.148052	31.88573	3.841466	0.0000

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.240713	54.79972	14.26460	0.0000
At most 1 *	0.148052	31.88573	3.841466	0.0000

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Model 2: Fama and French Three-Factor Model

Table 5.2. 4: RESI_TOP_10 MRP SMB HML
Sample (adjusted): 2000M06 2016M12

Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: RESI_TOP_10 MRP SMB HML
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.192307	119.9866	47.85613	0.0000
At most 1 *	0.146272	77.48560	29.79707	0.0000
At most 2 *	0.134658	46.01518	15.49471	0.0000
At most 3 *	0.082957	17.23368	3.841466	0.0000

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.192307	42.50102	27.58434	0.0003
At most 1 *	0.146272	31.47042	21.13162	0.0013
At most 2 *	0.134658	28.78150	14.26460	0.0001
At most 3 *	0.082957	17.23368	3.841466	0.0000

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.2. 5: INDI_TOP_25 MRP SMB HML
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: INDI_TOP25 HML MRP SMB
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.191489	113.3930	47.85613	0.0000
At most 1 *	0.141545	71.09334	29.79707	0.0000
At most 2 *	0.112917	40.72186	15.49471	0.0000
At most 3 *	0.081319	16.87838	3.841466	0.0000

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.191489	42.29969	27.58434	0.0003
At most 1 *	0.141545	30.37148	21.13162	0.0019
At most 2 *	0.112917	23.84347	14.26460	0.0012
At most 3 *	0.081319	16.87838	3.841466	0.0000

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.2. 6: FINI_TOP_15 MRP SMB HML
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: FINI_TOP_15 MRP SMB HML
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.315066	161.1551	47.85613	0.0000
At most 1 *	0.192897	85.84696	29.79707	0.0000
At most 2 *	0.124097	43.20055	15.49471	0.0000
At most 3 *	0.081109	16.83298	3.841466	0.0000

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.315066	75.30817	27.58434	0.0000
At most 1 *	0.192897	42.64642	21.13162	0.0000
At most 2 *	0.124097	26.36757	14.26460	0.0004
At most 3 *	0.081109	16.83298	3.841466	0.0000

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Model 3: Carhart Four Factor Model

Table 5.2. 7: RESI_TOP_10 HML MRP WML SMB
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: RESI_TOP_10 HML MRP WML SMB
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.242311	173.6564	69.81889	0.0000
At most 1 *	0.190263	118.4374	47.85613	0.0000
At most 2 *	0.143179	76.43929	29.79707	0.0000
At most 3 *	0.130212	45.68854	15.49471	0.0000
At most 4 *	0.086146	17.92690	3.841466	0.0000

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**

None *	0.242311	55.21894	33.87687	0.0000
At most 1 *	0.190263	41.99814	27.58434	0.0004
At most 2 *	0.143179	30.75075	21.13162	0.0016
At most 3 *	0.130212	27.76164	14.26460	0.0002
At most 4 *	0.086146	17.92690	3.841466	0.0000

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.2. 8: INDI_TOP_25 MRP HML SMB WML

Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: INDI_TOP25 MRP HML SMB WML
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.239077	165.3311	69.81889	0.0000
At most 1 *	0.187707	110.9596	47.85613	0.0000
At most 2 *	0.133242	69.58858	29.79707	0.0000
At most 3 *	0.111918	41.13250	15.49471	0.0000
At most 4 *	0.084244	17.51298	3.841466	0.0000

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.239077	54.37148	33.87687	0.0001
At most 1 *	0.187707	41.37103	27.58434	0.0005
At most 2 *	0.133242	28.45608	21.13162	0.0039
At most 3 *	0.111918	23.61951	14.26460	0.0013
At most 4 *	0.084244	17.51298	3.841466	0.0000

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.2. 9: FINI_TOP_15 MRP HML SMB WML

Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: FINI_TOP_15 HML MRP WML SMB
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.330658	213.6284	69.81889	0.0000
At most 1 *	0.224450	133.7378	47.85613	0.0000
At most 2 *	0.182994	83.15542	29.79707	0.0000
At most 3 *	0.120618	42.93576	15.49471	0.0000
At most 4 *	0.083527	17.35723	3.841466	0.0000

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.330658	79.89059	33.87687	0.0000
At most 1 *	0.224450	50.58243	27.58434	0.0000
At most 2 *	0.182994	40.21966	21.13162	0.0000
At most 3 *	0.120618	25.57853	14.26460	0.0006
At most 4 *	0.083527	17.35723	3.841466	0.0000

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Model 4: Fama and French Five-Factor Model

Table 5.2. 10: RESI_TOP_10 MRP HML CMA SMB RMW
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: RESI_TOP_10 MRP HML CMA SMB RMW
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.261154	209.6450	95.75366	0.0000
At most 1 *	0.211852	149.4145	69.81889	0.0000
At most 2 *	0.159773	102.0386	47.85613	0.0000
At most 3 *	0.137210	67.39601	29.79707	0.0000
At most 4 *	0.100736	38.02684	15.49471	0.0000
At most 5 *	0.081406	16.89732	3.841466	0.0000

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.261154	60.23057	40.07757	0.0001
At most 1 *	0.211852	47.37585	33.87687	0.0007
At most 2 *	0.159773	34.64261	27.58434	0.0053
At most 3 *	0.137210	29.36917	21.13162	0.0028
At most 4 *	0.100736	21.12952	14.26460	0.0035
At most 5 *	0.081406	16.89732	3.841466	0.0000

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.2. 11: INDI_TOP_25 MRP SMB HML RMW CMA
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: INDI_TOP25 MRP SMB HML RMW CMA
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**

None *	0.255596	203.8492	95.75366	0.0000
At most 1 *	0.219368	145.1100	69.81889	0.0000
At most 2 *	0.157683	95.82732	47.85613	0.0000
At most 3 *	0.108700	61.67926	29.79707	0.0000
At most 4 *	0.102858	38.77951	15.49471	0.0000
At most 5 *	0.082709	17.17974	3.841466	0.0000

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.255596	58.73922	40.07757	0.0002
At most 1 *	0.219368	49.28264	33.87687	0.0004
At most 2 *	0.157683	34.14807	27.58434	0.0062
At most 3 *	0.108700	22.89974	21.13162	0.0279
At most 4 *	0.102858	21.59977	14.26460	0.0029
At most 5 *	0.082709	17.17974	3.841466	0.0000

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.2.: FINI_TOP_15 MRP SMB HML RMW CMA
Sample (adjusted): 2000M06 2016M12
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: FINI_TOP_15 MRP SMB HML RMW CMA
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.336255	255.4856	95.75366	0.0000
At most 1 *	0.247171	173.9239	69.81889	0.0000
At most 2 *	0.217489	117.4243	47.85613	0.0000
At most 3 *	0.146206	68.61993	29.79707	0.0000
At most 4 *	0.096081	37.16490	15.49471	0.0000
At most 5 *	0.082170	17.06284	3.841466	0.0000

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.336255	81.56174	40.07757	0.0000
At most 1 *	0.247171	56.49964	33.87687	0.0000
At most 2 *	0.217489	48.80433	27.58434	0.0000
At most 3 *	0.146206	31.45503	21.13162	0.0013
At most 4 *	0.096081	20.10206	14.26460	0.0053
At most 5 *	0.082170	17.06284	3.841466	0.0000

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

C. Correlation

Correlation of the Four Factors

	MRP	*SMB*	*HML*	*WML*
MRP	1,0000			
SMB	0,0804	1,0000		
HML	0,4554	0,2482	1,0000	
WML	-0,4419	0,2297	-0,2407	1,0000

Correlation of the Five Factors

	MRP	*SMB*	*HML*	*RMW*	*CMA*
MRP	1,0000				
SMB	0,0726	1,0000			
HML	0,4428	0,2456	1,0000		
RMW	0,4298	0,3989	0,6441	1,0000	
CMA	0,5086	0,1815	0,8728	0,6145	1,0000

Correlation of all the variables

	MRP	*SMB*	*HML*	*WML*	*RMW*	*CMA*	*Top 40 Return*	*RESI Top 10*	*INDI Top25*	*FINI Top 15*
MRP	1,0000									
SMB	0,0804	1,0000								
HML	0,4554	0,2482	1,0000							
WML	-0,4419	0,2297	-0,2407	1,0000						
RMW	0,4581	0,3980	0,6727	-0,1253	1,0000					
CMA	0,5305	0,1845	0,8713	-0,3047	0,6363	1,0000				
Top 40 Return	-0,0558	-0,1441	-0,0507	-0,1432	-0,0620	-0,0689	1,0000			
RESI Top 10	0,8682	0,0086	0,6394	-0,4841	0,4561	0,6322	-0,0655	1,0000		
INDI Top25	0,8393	0,0370	0,1296	-0,3403	0,2582	0,2743	-0,0216	0,5229	1,0000	
FINI Top 15	0,6614	0,0613	0,0825	-0,3010	0,1376	0,2476	-0,0549	0,3712	0,7253	1,0000

D. Full data set results:

	MRP	SMB	HML	WML	RMW	CMA	Top 40 Return	RESI Top 10	INDI Top 25	FINI Top 15	FINI 30
31/01/00	-0,03341	0,02304	-0,00666	0,08582	-0,06248	-0,04081	0,13273	-0,06004	-0,00956	0,00331	-0,007
29/02/00	-0,07619	0,05194	-0,02585	0,16616	-0,02812	0,00652	-0,02626	-0,15320	0,00809	-0,06354	-0,019
31/03/00	0,00477	-0,00404	0,01640	0,10912	-0,00135	0,01294	-0,06235	0,02562	-0,02734	0,01610	-0,013
30/04/00	-0,07133	0,04281	0,02186	0,08474	-0,00555	0,02337	0,01387	-0,08725	-0,07989	-0,02932	-0,060
31/05/00	-0,00969	0,04384	0,03068	0,13007	0,01541	0,00541	-0,06427	0,03744	-0,04428	-0,05245	-0,042
30/06/00	0,05833	0,01444	0,04566	-0,03590	0,05338	0,04277	0,00115	0,07170	0,07233	0,00873	0,049
31/07/00	0,00705	0,04280	0,01735	0,04316	-0,00490	-0,01719	0,05533	0,00638	0,00799	0,00897	0,011
31/08/00	0,09900	0,00140	-0,03110	0,05302	-0,00459	-0,02537	0,01065	0,15276	0,06028	0,08068	0,063
30/09/00	-0,03196	0,03028	0,03039	0,10691	0,02428	0,01850	0,10342	-0,02983	-0,02495	-0,05828	-0,032
31/10/00	-0,01096	0,01662	0,03457	0,09188	0,03282	0,02536	-0,02305	0,03897	-0,05284	-0,05596	-0,049
30/11/00	-0,05824	0,03952	0,06087	0,16210	0,00931	0,04057	-0,00330	-0,03791	-0,10669	-0,00383	-0,068
31/12/00	0,06110	0,08318	0,02442	-0,00114	0,02193	0,03443	-0,04473	0,04498	0,03660	0,14252	0,074
31/01/01	0,09722	-0,03711	-0,03066	-0,00026	-0,02066	-0,05445	0,06100	0,14825	0,06798	0,04512	0,058
28/02/01	-0,00505	-0,03704	0,03158	0,07041	0,01900	-0,00239	0,09720	0,08027	-0,08471	-0,07033	-0,077
31/03/01	-0,10051	0,00537	-0,02992	0,05059	-0,06120	-0,07380	0,00082	-0,08428	-0,14604	-0,07609	-0,115
30/04/01	0,09816	0,07172	0,07143	0,06521	0,06754	0,04861	-0,09629	0,12437	0,08775	0,05266	0,075
31/05/01	0,04756	0,02099	-0,00371	-0,04979	-0,01091	-0,02083	0,10359	0,05829	0,02831	0,04498	0,038
30/06/01	-0,02885	-0,02479	-0,01552	0,02885	-0,03817	-0,01907	0,04341	-0,06865	-0,00647	0,03612	0,009
31/07/01	-0,08802	-0,01912	-0,08304	0,13679	-0,03063	-0,09588	-0,02645	-0,10166	-0,10487	-0,04601	-0,082
31/08/01	0,04792	0,00171	0,03442	0,04204	0,01330	0,02765	-0,07662	0,10575	0,01863	-0,01482	0,003
30/09/01	-0,11961	0,03077	0,01142	0,13507	-0,00360	-0,06132	0,05142	-0,09356	-0,14545	-0,12239	-0,130
31/10/01	0,06312	-0,00019	-0,01229	0,04578	-0,02972	0,00567	-0,10835	0,09929	0,06240	-0,00968	0,028
30/11/01	0,11983	-0,00408	0,02218	-0,05356	0,03898	0,00915	0,06694	0,20452	0,09050	-0,00668	0,045
31/12/01	0,11328	0,07214	0,19041	0,10466	0,12713	0,11982	0,11537	0,20610	0,03223	0,00781	0,025
31/01/02	-0,01428	-0,00039	-0,01132	0,07082	0,01699	-0,02453	0,12200	0,01101	-0,01867	-0,06905	-0,039
28/02/02	0,05418	0,05088	0,04592	0,07670	0,08996	-0,00547	-0,00838	0,09776	0,01662	-0,00378	0,009
31/03/02	0,01109	0,01240	0,02338	0,01777	0,03220	-0,00263	0,06057	0,01290	0,03025	-0,01072	0,012
30/04/02	-0,01198	0,03169	-0,00534	0,02556	0,00329	-0,00924	0,01257	-0,06339	-0,00031	0,12686	0,049
31/05/02	0,01401	-0,08184	-0,03947	-0,01311	-0,02613	-0,01594	-0,00985	0,02363	0,03218	-0,01985	0,007
30/06/02	-0,05553	-0,03323	-0,01971	0,03891	-0,01039	-0,04031	0,01292	-0,05643	-0,05071	-0,04678	-0,053
31/07/02	-0,15233	-0,01650	-0,08957	0,10973	-0,07610	-0,07442	-0,05228	-0,18290	-0,13403	-0,09484	-0,118
31/08/02	0,04724	0,06112	0,00037	0,05973	0,01395	-0,01744	-0,14319	0,08300	0,01639	0,00766	0,012
30/09/02	-0,03109	0,02833	-0,00647	0,06846	0,02042	-0,00690	0,05221	0,02152	-0,09776	-0,05336	-0,083
31/10/02	-0,01750	-0,03702	-0,04668	0,02116	-0,05267	-0,05784	-0,02539	-0,05250	0,02438	0,02604	0,023
30/11/02	0,01182	-0,04135	-0,06847	0,05017	-0,08232	-0,07133	-0,01573	-0,03136	0,04214	0,07560	0,057
31/12/02	-0,03461	-0,01796	-0,03372	0,00186	-0,02019	-0,03900	0,01600	0,00449	-0,05516	-0,08142	-0,071
31/01/03	-0,06342	-0,01640	0,01697	0,07160	0,02266	0,01832	-0,03446	-0,07089	-0,06855	-0,03748	-0,054
28/02/03	-0,05184	-0,00516	-0,07547	0,05519	-0,04678	-0,05376	-0,05745	-0,04111	-0,07150	-0,05054	-0,064
31/03/03	-0,09659	-0,02409	-0,07158	0,08044	-0,04909	-0,05466	-0,04724	-0,08995	-0,11317	-0,09162	-0,101
30/04/03	-0,03121	-0,01052	-0,05642	0,08490	-0,05945	-0,04764	-0,08989	-0,09458	0,01753	0,04882	0,034
31/05/03	0,15366	0,04059	0,14480	-0,08382	0,08370	0,10463	-0,02414	0,20341	0,11498	0,09666	0,106
30/06/03	-0,03908	-0,04451	-0,05625	0,07694	-0,04882	-0,04326	0,14667	-0,07229	-0,01398	0,00420	-0,002
31/07/03	0,05033	0,03687	0,00288	0,03270	0,04149	-0,01780	-0,03267	0,05895	0,05779	0,02749	0,039

31/08/03	0,04474	-0,03359	-0,00367	0,03002	-0,00313	-0,04938	0,05305	0,09428	0,03377	-0,03897	-0,001
30/09/03	-0,03969	-0,03507	-0,04237	0,04651	-0,00857	-0,02949	0,04724	-0,05612	-0,00799	-0,03658	-0,020
31/10/03	0,09206	-0,01415	-0,00894	0,07020	-0,04599	-0,02736	-0,03581	0,09863	0,08444	0,07855	0,081
30/11/03	-0,01546	-0,01267	-0,07220	0,07592	-0,01950	-0,04476	0,09791	-0,06093	0,04737	0,01865	0,032
31/12/03	0,06846	-0,02357	0,01577	0,00379	-0,00357	-0,00186	-0,00913	0,08682	0,05007	0,04871	0,049
31/01/04	0,04499	-0,01986	0,05879	0,03885	0,02997	0,04869	0,06877	0,04538	0,04702	0,03746	0,045
29/02/04	0,00016	-0,00986	-0,04048	0,06034	0,01942	-0,05155	0,04823	-0,00085	-0,00874	0,00432	-0,002
31/03/04	-0,02465	-0,00652	-0,05733	0,01735	-0,02739	-0,05626	0,00519	-0,06014	0,01390	0,00648	0,010
30/04/04	-0,03822	-0,00445	-0,04842	0,06809	-0,00549	-0,05198	-0,02320	-0,08295	0,01024	-0,01268	-0,000
31/05/04	0,00661	0,00788	0,03065	0,01047	0,01136	0,00991	-0,03255	0,00166	0,00125	0,01485	0,009
30/06/04	-0,03708	-0,01263	-0,03837	0,03515	0,01022	-0,04125	0,00749	-0,07398	-0,01673	0,00364	-0,008
31/07/04	0,01973	0,01460	-0,03563	0,03009	-0,01797	-0,02846	-0,03415	0,04460	-0,00321	0,00260	-0,002
31/08/04	0,08964	0,01975	0,04319	-0,00803	0,02194	0,01151	0,02224	0,12496	0,06307	0,05260	0,058
30/09/04	0,04492	0,04810	-0,01454	0,09184	-0,10673	-0,01286	0,08897	0,03405	0,03139	0,08721	0,053
31/10/04	-0,03228	0,00445	-0,07904	0,13762	-0,04277	-0,07804	0,05257	-0,10035	0,04269	0,00764	0,022
30/11/04	0,06073	-0,02488	-0,06559	0,09795	0,00868	-0,04824	-0,02081	0,00751	0,09906	0,10258	0,098
31/12/04	0,00344	0,00940	-0,04368	0,08892	-0,00261	-0,03856	0,06889	-0,04741	0,03096	0,03713	0,036
31/01/05	0,00949	0,01462	0,00536	0,01781	0,02354	-0,00117	0,01085	0,04015	-0,01277	-0,00887	-0,010
28/02/05	0,05656	-0,01845	0,02852	0,00591	0,02124	0,03650	0,01098	0,10797	0,02704	0,02366	0,023
31/03/05	-0,00715	-0,00904	0,02298	-0,01804	0,00202	0,01239	0,05705	0,00186	-0,01823	-0,01429	-0,014
30/04/05	-0,06913	0,00683	-0,07042	0,07557	-0,00839	-0,04685	-0,00865	-0,09492	-0,05598	-0,03836	-0,052
31/05/05	0,10732	0,00459	0,04722	-0,02196	0,00083	0,03615	-0,06283	0,16723	0,08028	0,04791	0,067
30/06/05	0,02502	-0,00374	-0,00562	0,02626	-0,05091	-0,00514	0,10549	0,02232	0,03562	0,01625	0,026
31/07/05	0,06479	0,00206	-0,03004	0,03119	0,01868	-0,03187	0,02720	0,04784	0,07952	0,07549	0,076
31/08/05	0,01244	-0,01805	-0,02063	0,04636	-0,01308	-0,00126	0,06739	0,02067	0,01050	0,00205	0,006
30/09/05	0,09786	-0,00049	0,01738	0,04211	-0,02231	0,04783	0,01630	0,15275	0,07941	0,02767	0,057
31/10/05	-0,02680	0,01351	-0,01720	-0,00454	-0,00963	-0,02532	0,10137	-0,03059	-0,02925	-0,02053	-0,024
30/11/05	0,01599	0,02224	0,05816	0,03512	0,03120	0,03093	-0,02718	0,02684	-0,00041	0,02938	0,009
31/12/05	0,07612	0,03702	-0,01922	0,03937	-0,02371	0,00349	0,01892	0,06852	0,07436	0,09499	0,082
31/01/06	0,08637	0,00182	0,04204	0,02068	0,02911	0,02181	0,07940	0,11724	0,06128	0,07481	0,063
28/02/06	-0,04797	0,02593	-0,04435	0,06505	-0,00609	-0,02324	0,08810	-0,08320	-0,01982	-0,01233	-0,018
31/03/06	0,06777	-0,01141	0,00714	0,02036	-0,02278	0,00589	-0,04255	0,08091	0,05706	0,05666	0,058
30/04/06	0,03997	0,00093	0,01650	0,01848	0,02510	0,01484	0,06946	0,07783	0,02057	0,00036	0,010
31/05/06	-0,02286	0,00592	0,04633	0,01330	0,00447	0,02757	0,04151	0,01745	-0,06593	-0,05144	-0,055
30/06/06	0,04040	-0,06211	0,01928	0,08001	-0,02037	0,00813	-0,02175	0,09475	-0,01215	-0,01996	-0,011
31/07/06	-0,02270	0,01542	0,01432	0,02005	0,01945	0,03663	0,04706	-0,05076	0,00535	0,00942	0,007
31/08/06	0,05043	-0,03869	-0,03363	0,00110	-0,03383	-0,01677	-0,02103	0,05131	0,05856	0,03612	0,049
30/09/06	0,01442	-0,01544	0,00168	0,06708	-0,00764	0,01107	0,05052	-0,00673	0,03105	0,03331	0,036
31/10/06	0,03927	0,03612	0,00749	-0,00127	-0,00035	-0,00778	0,02001	0,03205	0,04417	0,05454	0,044
30/11/06	0,01965	0,00362	0,00182	0,02345	0,01497	0,02335	0,03917	0,00846	0,04335	0,01659	0,029
31/12/06	0,03481	-0,01709	0,01904	0,05021	0,03473	-0,00734	0,02160	-0,00429	0,07900	0,05240	0,073
31/01/07	0,01144	0,03094	-0,03703	0,04034	0,00706	-0,03808	0,03900	0,00306	0,02322	0,02077	0,019
28/02/07	0,01010	0,01351	-0,00837	0,00134	0,02196	0,01788	0,01480	0,02635	-0,00270	0,00891	-0,001
31/03/07	0,06079	0,02224	0,02570	0,00272	0,03329	0,00907	0,01021	0,09946	0,02728	0,02372	0,027
30/04/07	0,02278	-0,04573	-0,05852	0,03966	-0,05229	-0,04604	0,06102	-0,00923	0,06037	0,05404	0,056
31/05/07	0,01438	0,03298	-0,00056	0,05087	0,02836	0,00448	0,02609	0,06194	-0,01348	-0,05273	-0,027

30/06/07	-0,00589	0,02749	0,01842	0,00683	0,03319	0,03254	0,01862	0,00753	-0,01283	-0,04218	-0,020
31/07/07	0,01075	0,03265	0,00714	0,00334	-0,00437	0,00347	-0,00532	0,01201	0,01284	0,00797	0,011
31/08/07	-0,00027	0,02377	-0,00804	0,06675	0,01123	0,00406	0,01102	-0,01606	0,02384	-0,00671	0,012
30/09/07	0,04674	-0,01248	0,00355	0,03237	-0,02879	-0,02984	0,00529	0,11822	-0,01030	-0,03944	-0,021
31/10/07	0,03995	0,01798	-0,01510	0,05282	0,01377	0,00094	0,04943	0,00714	0,05626	0,10978	0,076
30/11/07	-0,03521	-0,01352	0,02554	0,06532	-0,00206	0,02790	0,04436	-0,03271	-0,02184	-0,07311	-0,038
31/12/07	-0,05340	-0,02079	-0,03096	0,04179	-0,00911	-0,03963	-0,02977	-0,06533	-0,02781	-0,05957	-0,039
31/01/08	-0,04563	0,02815	0,09676	0,02980	0,02555	0,02987	-0,04991	0,02954	-0,12085	-0,12831	-0,122
29/02/08	0,12192	0,07670	0,09533	0,08017	0,11390	0,08793	-0,04314	0,16815	0,07203	0,06497	0,071
31/03/08	-0,03534	0,00463	0,03682	0,02702	0,00424	0,00687	0,12860	-0,04117	-0,00830	-0,07770	-0,027
30/04/08	0,04285	0,02760	0,03816	0,03975	0,06853	0,01858	-0,03308	0,04417	0,05042	0,00497	0,038
31/05/08	0,03909	0,00688	0,07175	0,06015	0,04614	0,03026	0,04616	0,06223	0,04679	-0,07520	0,008
30/06/08	-0,04376	0,03152	0,04686	0,03143	0,01926	0,02458	0,04410	0,01042	-0,11492	-0,10348	-0,112
31/07/08	-0,10554	0,06818	-0,08505	0,04223	-0,05211	-0,08031	-0,04114	-0,19462	-0,01111	0,12402	0,026
31/08/08	-0,01336	0,01757	-0,03640	0,05682	0,01064	-0,00392	-0,10202	-0,03373	0,01701	0,00335	0,009
30/09/08	-0,15463	0,00976	-0,02788	0,06671	-0,06060	-0,01746	-0,00863	-0,23148	-0,08811	-0,03468	-0,069
31/10/08	-0,13885	0,03450	-0,08616	0,19465	-0,05847	-0,06995	-0,14907	-0,19010	-0,04533	-0,15635	-0,091
30/11/08	0,00662	0,05085	-0,01045	0,08797	0,01396	-0,02153	-0,12263	0,04387	-0,06387	0,03429	-0,031
31/12/08	0,00225	0,00371	-0,04155	0,03385	-0,01922	-0,06619	0,01395	-0,00501	0,03574	-0,02972	0,011
31/01/09	-0,05345	0,05204	-0,03890	0,07077	-0,03945	-0,02729	0,00507	-0,03220	-0,05609	-0,08873	-0,069
28/02/09	-0,11472	0,08735	0,05567	0,07714	0,00809	-0,02879	-0,04755	-0,10204	-0,11629	-0,12906	-0,122
31/03/09	0,11752	-0,05281	0,07493	-0,00974	0,04970	0,08808	-0,10829	0,14398	0,06262	0,12357	0,089
30/04/09	0,00463	0,00345	-0,06077	-0,00830	-0,01471	-0,03691	0,11671	-0,03057	0,04866	0,04594	0,042
31/05/09	0,11165	0,04140	0,05491	0,01553	0,02651	0,02240	0,00394	0,16245	0,07974	0,02916	0,061
30/06/09	-0,04246	-0,03620	-0,05061	0,05187	0,00422	-0,02893	0,11294	-0,09452	-0,00348	0,04112	0,014
31/07/09	0,09959	-0,00026	0,00050	0,03778	0,01668	0,04146	-0,03814	0,09492	0,10155	0,09874	0,104
31/08/09	0,02231	0,00517	0,02119	0,02492	0,00405	0,02248	0,10274	0,01013	0,03325	0,04502	0,035
30/09/09	-0,00622	-0,05638	-0,06229	0,01860	-0,04733	-0,07194	0,02439	-0,00827	0,00316	-0,01494	-0,007
31/10/09	0,05913	0,03799	0,00926	0,02882	0,02001	-0,01011	-0,00467	0,06955	0,05045	0,04571	0,049
30/11/09	0,02687	-0,02273	0,00673	0,03367	-0,03423	0,00979	0,06154	0,05612	0,00171	-0,01821	-0,002
31/12/09	0,02260	-0,03576	-0,02568	0,04372	-0,00607	-0,00829	0,02968	0,02155	0,02874	0,02264	0,024
31/01/10	-0,04149	-0,02927	-0,00597	0,03913	-0,01695	-0,01225	0,02624	-0,06733	-0,03447	0,01172	-0,014
28/02/10	-0,00479	0,00858	0,00092	0,03413	0,01726	0,00220	-0,03823	-0,01292	0,00864	0,00255	0,003
31/03/10	0,07369	0,00198	0,01990	0,03535	0,03021	0,01735	-0,00194	0,09264	0,05121	0,06710	0,057
30/04/10	-0,00906	-0,01645	-0,01574	0,01414	-0,00674	-0,00347	0,07664	-0,01865	0,00636	-0,00641	0,001
31/05/10	-0,06072	-0,01029	-0,01759	0,03946	-0,01199	-0,03457	-0,00788	-0,06824	-0,04064	-0,06643	-0,054
30/06/10	-0,03998	-0,00715	-0,01637	0,05100	-0,03058	-0,01139	-0,05743	-0,04606	-0,02956	-0,04181	-0,035
31/07/10	0,07891	0,03215	0,02325	0,04717	0,01728	0,00731	-0,03573	0,05557	0,09282	0,10686	0,098
31/08/10	-0,04787	-0,02170	-0,05509	0,05234	-0,06278	-0,05433	0,08284	-0,06890	-0,01951	-0,04627	-0,030
30/09/10	0,08031	0,00870	-0,01967	0,04454	0,00682	-0,03300	-0,04351	0,06779	0,09315	0,07558	0,089
31/10/10	0,03216	0,00968	-0,00410	0,02670	0,01649	-0,00337	0,08402	0,07987	0,01281	-0,03739	-0,006
30/11/10	-0,01056	-0,03232	-0,02517	0,03399	-0,00289	-0,02253	0,03439	-0,00642	-0,00543	-0,03213	-0,013
31/12/10	0,06448	0,02156	0,02855	0,02864	0,03696	0,01861	-0,00773	0,07479	0,05576	0,04818	0,055
31/01/11	-0,01836	-0,00295	0,02689	0,01327	0,00340	0,02092	0,06686	-0,00567	-0,04321	-0,01360	-0,030
28/02/11	0,03018	0,01217	0,03475	0,03540	0,03203	0,01821	-0,01725	0,04956	0,02189	-0,00787	0,013
31/03/11	-0,00344	-0,01164	0,00034	0,02460	-0,00927	-0,02357	0,03313	-0,03166	0,01562	0,02054	0,019

30/04/11	0,01630	0,00728	-0,01016	0,02207	0,00671	-0,01982	-0,00139	-0,00198	0,04017	0,01409	0,032
31/05/11	-0,01039	-0,00317	-0,01665	0,00686	-0,01523	-0,00260	0,01814	-0,02912	0,00961	-0,00116	0,005
30/06/11	-0,02621	-0,00415	-0,01252	0,01852	-0,00396	-0,02277	-0,00982	-0,03153	-0,01666	-0,02656	-0,020
31/07/11	-0,02810	-0,01840	-0,04565	0,04558	-0,01773	-0,05148	-0,02467	-0,04938	-0,00557	-0,02783	-0,01
31/08/11	-0,01006	0,01356	0,01939	0,04506	0,03085	0,01383	-0,02430	-0,02116	-0,00630	0,00691	-0,00
30/09/11	-0,05068	-0,04498	-0,03904	0,04177	-0,02674	-0,02034	-0,00630	-0,05796	-0,04518	-0,04249	-0,04
31/10/11	0,09713	0,01108	0,01628	0,03702	0,01934	0,00279	-0,04719	0,10660	0,10146	0,05242	0,088
30/11/11	0,01150	-0,01321	-0,04228	0,03194	-0,01193	-0,03532	0,10021	0,01635	0,00565	0,00900	0,006
31/12/11	-0,03522	-0,01836	-0,05391	0,03117	-0,03150	-0,02967	0,01416	-0,05432	-0,02733	0,01392	-0,01
31/01/12	0,05782	-0,01880	-0,00029	0,02536	-0,00947	0,00420	-0,03262	0,08092	0,03263	0,06327	0,040
29/02/12	0,00825	0,02827	-0,00253	0,04831	0,00807	-0,00960	0,05994	-0,03427	0,03611	0,04232	0,037
31/03/12	-0,03536	-0,02227	-0,06653	0,05372	-0,01949	-0,04394	0,01228	-0,09461	0,01235	-0,00080	0,006
30/04/12	0,02341	0,01792	-0,01397	0,02765	-0,00332	-0,00788	-0,03088	0,02334	0,03177	0,01302	0,025
31/05/12	-0,04203	0,01239	-0,01360	0,04481	0,00331	-0,01807	0,02571	-0,07623	-0,02587	-0,01567	-0,02
30/06/12	0,01111	-0,02715	-0,04829	0,04585	-0,01520	-0,03021	-0,03829	0,00944	0,01468	0,02075	0,014
31/07/12	0,01807	0,01643	-0,04592	0,08631	-0,01687	-0,03660	0,01493	-0,02715	0,05084	0,02252	0,043
31/08/12	0,02054	-0,01965	-0,04609	0,06393	-0,01882	-0,03575	0,02526	-0,01306	0,04724	0,01581	0,039
30/09/12	0,01122	0,00003	0,01700	-0,00166	0,02020	0,01338	0,02587	0,04756	-0,00830	-0,00764	-0,008
31/10/12	0,04419	0,03570	0,01060	0,03699	0,00466	0,00175	0,01109	0,05448	0,04394	0,01017	0,038
30/11/12	0,01861	0,02612	-0,05636	0,09095	-0,04262	-0,04158	0,04727	-0,02814	0,05226	0,01469	0,043
31/12/12	0,02789	-0,00263	0,01789	-0,00780	-0,00646	0,01399	0,02619	0,02959	0,01782	0,06450	0,027
31/01/13	0,03263	-0,03986	0,00801	0,05947	0,01570	0,03588	0,02724	0,03235	0,02899	0,03113	0,034
28/02/13	-0,02592	-0,00351	-0,05273	0,02891	-0,01327	-0,02709	0,03759	-0,06623	-0,00136	-0,01250	-0,00
31/03/13	-0,00308	-0,01776	-0,02000	0,03843	-0,02327	-0,00299	-0,02351	-0,04273	0,01935	0,01669	0,016
30/04/13	-0,03962	-0,02748	-0,05850	0,07007	-0,04401	-0,05096	0,00012	-0,09331	-0,00746	-0,01794	-0,01
31/05/13	0,09843	0,03862	0,05977	0,06290	0,06068	0,06111	-0,03378	0,11892	0,11033	0,01557	0,089
30/06/13	-0,07304	-0,01350	-0,05507	0,06322	-0,03590	-0,04866	0,10367	-0,14051	-0,03778	-0,04707	-0,04
31/07/13	0,04963	-0,00699	0,02196	0,01775	0,00230	0,02168	-0,06778	0,08941	0,03349	0,02070	0,032
31/08/13	0,02571	0,00039	0,01996	0,02394	0,01516	0,00697	0,05111	0,06740	0,00944	-0,00950	0,007
30/09/13	0,03880	0,03297	-0,00374	0,03697	0,01082	-0,00143	0,02771	0,00688	0,05444	0,05165	0,053
31/10/13	0,02893	0,00141	-0,02736	0,02051	-0,02228	-0,00049	0,04188	0,02203	0,02428	0,06832	0,032
30/11/13	-0,01403	-0,03034	-0,01278	0,02400	-0,00295	0,00934	0,03064	-0,02270	-0,00254	-0,03251	-0,01
31/12/13	0,02831	0,01128	0,00592	0,05249	0,01402	0,00760	-0,01203	0,01339	0,03722	0,02297	0,035
31/01/14	-0,02408	-0,06184	0,05811	0,02991	-0,02131	0,02949	0,03269	0,05437	-0,05249	-0,07377	-0,05
28/02/14	0,05017	0,04247	0,02716	0,04389	0,01741	0,03774	-0,02159	0,04026	0,04724	0,08016	0,055
31/03/14	0,00322	0,03860	-0,01614	0,02445	0,04324	0,00459	0,05383	-0,01457	0,00126	0,05247	0,010
30/04/14	0,01839	-0,01467	-0,01335	0,00482	0,00814	-0,00366	0,00526	0,03475	0,01188	0,02346	0,011
31/05/14	0,01642	0,00524	-0,02567	0,03222	0,00247	-0,01571	0,01879	-0,04538	0,04835	0,01673	0,042
30/06/14	0,02565	0,02949	0,00483	0,04930	-0,01226	-0,00207	0,01910	0,03044	0,02262	0,02288	0,024
31/07/14	0,00427	0,01519	0,01067	0,01469	0,01103	0,01972	0,02975	0,05003	-0,01486	0,00275	-0,01
31/08/14	-0,01683	-0,03344	-0,02065	0,04825	-0,00992	-0,01294	0,00550	-0,06231	0,00591	0,00300	0,005
30/09/14	-0,03943	-0,00686	-0,06133	0,08653	-0,00642	-0,05161	-0,01281	-0,07530	-0,02425	-0,03421	-0,02
31/10/14	-0,00449	-0,00474	-0,02924	0,11490	0,02153	-0,01065	-0,03222	-0,11210	0,03029	0,05446	0,035
30/11/14	-0,01231	0,05501	-0,03383	0,09931	-0,00915	-0,00308	0,00509	-0,07104	0,00832	0,02150	0,008
31/12/14	-0,00953	-0,00114	-0,03034	0,05037	-0,03731	-0,03064	-0,00404	-0,05573	0,00629	-0,00349	0,005
31/01/15	0,01800	0,01962	0,01333	0,09545	0,00748	-0,00154	-0,00533	-0,00442	0,02324	0,03774	0,025

28/02/15	0,04237	-0,00010	0,01966	0,03705	0,00808	0,01743	0,02595	0,08370	0,02882	0,03080	0,029
31/03/15	-0,03320	0,02386	-0,02716	0,10705	0,01786	-0,02430	0,04546	-0,11210	-0,01976	0,00705	-0,012
30/04/15	0,04576	0,00412	0,02370	0,01893	0,00062	0,02852	-0,02427	0,07703	0,03990	0,03395	0,040
31/05/15	-0,04069	0,01197	-0,04522	0,01278	-0,00795	-0,04414	0,04734	-0,05348	-0,03247	-0,06872	-0,040
30/06/15	-0,00905	0,03124	0,00267	0,07122	0,04730	-0,01128	-0,03963	-0,07242	0,00232	-0,01137	0,000
31/07/15	-0,00160	0,08649	-0,04949	0,12725	0,03302	-0,04458	-0,00311	-0,08712	0,00344	0,02245	0,008
31/08/15	-0,05044	0,02209	-0,00464	0,03636	-0,01955	-0,02377	0,00901	-0,01141	-0,05472	-0,04375	-0,055
30/09/15	-0,00022	0,06234	-0,03261	0,14639	0,04186	-0,06559	-0,04741	-0,12919	0,03418	-0,04248	0,020
31/10/15	0,07360	-0,01200	0,00241	0,03552	-0,03699	0,02216	0,01197	0,05304	0,08005	0,06463	0,076
30/11/15	-0,05373	0,05731	-0,08389	0,15109	0,01657	-0,09438	0,07656	-0,23777	-0,02493	-0,05216	-0,027
31/12/15	-0,01540	0,06728	-0,05780	0,04691	-0,03863	-0,04102	-0,04114	-0,02302	-0,00519	-0,06669	-0,017
31/01/16	-0,04351	-0,00782	0,08136	0,06831	0,02124	0,01991	-0,01149	-0,05078	-0,03241	-0,04017	-0,034
29/02/16	-0,01088	-0,01641	0,15016	0,05894	0,01388	0,06620	-0,03781	0,12702	-0,03118	-0,03366	-0,030
31/03/16	0,05281	0,00126	0,04190	0,00658	0,00580	0,04110	-0,00597	0,04183	0,04088	0,10996	0,051
30/04/16	0,00563	-0,03337	0,03541	0,01858	-0,01617	0,01581	0,05336	0,12397	-0,01541	-0,02616	-0,021
31/05/16	0,03045	-0,01169	-0,04133	0,02269	-0,00217	-0,02669	0,00717	-0,02840	0,05737	-0,02371	0,046
30/06/16	-0,04820	-0,00196	0,02245	0,07823	0,02481	0,02197	0,03234	-0,03994	-0,04746	-0,03450	-0,048
31/07/16	-0,00623	-0,01721	0,02923	0,05971	0,00091	0,00032	-0,04168	0,02841	-0,01397	0,02153	-0,010
31/08/16	0,00444	0,01397	-0,01376	0,03671	0,00148	-0,00611	-0,00126	-0,00990	0,01207	-0,03189	0,008
30/09/16	-0,02345	-0,02893	-0,03494	0,06466	-0,04910	-0,04995	0,00750	0,03831	-0,04963	-0,00134	-0,038
31/10/16	-0,03680	-0,06959	-0,01413	0,07007	-0,01882	-0,03385	-0,01806	-0,04416	-0,03690	-0,02422	-0,032
30/11/16	-0,01389	-0,00642	0,02377	0,07723	0,01509	0,03182	-0,03096	0,06211	-0,05067	0,00522	-0,035
31/12/16	-0,00173	-0,01590	-0,00739	0,02074	0,00594	0,01561	-0,00745	-0,00173	-0,00173	-0,00173	-0,001