Effect of Macroeconomic Variables on Stock Returns under Changing Market Conditions: Evidence from the JSE Sectors

Fabian Moodley

214582814

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University of KwaZulu-Natal

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Supervisor: Dr Ntokozo Nzimande

Co-Supervisor: Prof. Paul-Francois Muzindutsi

DECLARATION

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ABSTRACT

The equity market is seen as one of the key determinants of the fraternity of finance, as it unites investors with ambitions to invest in marketable instruments to earn a return on their investments. The equity market not only unites investors with similar ambitions, but is an important economic stimulus because it contributes a significant portion to economic growth. Underlying financial theories illustrate an interaction between stock market returns and macroeconomic variables. However, recently a debate has arisen in relation to the type of effect that is evident between macroeconomic variables and stock market returns. This debate is centred on the efficient market hypothesis (EMH), which depicts a linear effect and the adaptive market hypothesis (AMH), which advocates for a nonlinear affect. Thus, there is no empirical agreement regarding the relationship between macroeconomic variables and stock market returns. In an attempt to contribute to the debate, the study examined the interaction between macroeconomic variables and the Johannesburg Stock Exchange (JSE) indices returns under changing market conditions. The study's objective was to establish the effect between macroeconomic variables and stock market returns in a bullish and a bearish market condition and to compare the expected duration of each market condition among the selected JSE index returns.

The study used the Markov regime-switching model of conditional mean with constant transition probabilities. Moreover, preliminary tests in the form of graphical visualisations, descriptive statistics, correlation tests, unit root tests and stationarity tests with and without structural breaks were considered. The variables that formed part of the JSE consisted of the real values associated with the JSE All-Share Index, Industrial Metals and Mining Index, Consumer Goods 3000 Index, Consumer Services 5000 Index, Telecommunications 6000 Index, Financials 8000 Index and the Technologies 9000 Index. The macroeconomic variables included the real values of inflation (CPI) rate, industrial production rate, short-term interest rate, long-term interest rate, money supply (M2) and real effective exchange rate (REER). The JSE index returns series and the macroeconomic variable series contained monthly data that ranged from January 1996 to December 2018.

The findings of the regressed model illustrated the JSE All-Share Index returns are negatively affected by long-term interest growth rate in a bull market condition, by short-term interest

growth rate in a bear market condition, and positively affected by industrial production growth rate in a bear market condition. The Industrial Metal and Mining Index returns are negatively affected by inflation growth rate in the bear market condition. The Consumable Goods Index returns are positively influenced by growth rate of real effective exchange rate in a bullish market condition, negatively affected by inflation growth rate, short-term interest growth rate and growth rate of REER in a bear market condition. The Consumable Service Index returns are negatively affected by short-term interest growth rate in a bull market condition and long-term interest growth rate in a bear market condition. The Telecommunication Index returns are negatively affected by long-term interest growth rate in the bull and bear market conditions and positively affected by growth rate of REER in a bear market condition. The Financial Index returns are negatively affected by long-term interest growth rate in a bull and bear market and short-term interest growth rate in a bear market condition. The Technologies Index returns are positively affected by growth rate of REER in a bull market condition. Moreover, the bull market condition prevailed the longest across the JSE selected indices.

The findings of this study are consistent with AMH as it suggests that the efficiency and inefficiency of equity markets are owing to changing market conditions. Hence, macroeconomic variables affect the stock market returns differently under changing market conditions. Moreover, the findings were seen to contradict EMH as it suggests equity markets are efficient. As a result, the alternating efficiency effect under changing market conditions suggests that the effect of macroeconomic variables on stock market returns is explained by AMH and could be better modelled by nonlinear models. Thus, policymakers should consider that the effect of macroeconomic variables on JSE index returns varies with regimes and, therefore, develop appropriate policies.

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LIST OF ABBREVIATIONS

ADF	Augmented-Dickey Fuller
AIC	Akaike information criterion
AMH	Adaptive market hypothesis
APT	Arbitrage pricing theory
ARCH	Autoregressive conditional heteroskedasticity
ARDL	Autoregressive distributed lag
ARIMA	Autoregressive integrated moving average
BRICS	Brazil, Russia, India, China and South Africa
BVAR	Bayesian vector autoregressive
CAPM	Capital asset pricing model
CPI	Consumer price index
ECM	Error correction model
E-GARCH	Exponential generalised autoregressive conditional heteroskedasticity
EMH	Efficient market hypothesis
EMU	Economic monetary union
GDP	Gross domestic product
HQIC	Hannan and Quinn information criteria
JSE	Johannesburg Stock Exchange
KPSS	Kwiatkowski, Phillips, Schmidt and Shin
MS-DR	Markov switching dynamic regression
MS-VAR	Markov switching vector autoregressive
NARDL	Nonlinear autoregressive distribution lag
NECM	Nonlinear error correction models
NYSE	New York Stock Exchange
OLS	Ordinary least squares
PP	Phillips and Perron
REIT	Real estate investment rust
REER	Real effective exchange rate
SA	South African
SAARC	South Asian association for regional cooperation
SARB	South African Reserve Bank

SBIC	Bayesian information criterion
STM	Smooth transition model (STM)
SVAR	Structural vector autoregressive
T-GARCH	Threshold generalised autoregressive conditional heteroscedasticity
UK	United Kingdom
US	United States
VAR	Vector autoregressive
VECM	Vector error correction model
VIX	Volatility Index

CHAPTER 1: INTRODUCTION

1.1. Background

Capital markets significantly affect the world economy (Bekaert and Harvey, 2017). Their effect is traced back to the development of the Dow Jones Index by Dow Jones and Co in 1884 (Duarte, Machado and Duarte, 2010). Capital markets, which include but are not limited to equity markets, is developed to unite investors with ambitions to invest in marketable instruments to earn a return on their investments. The first stock market was developed in Antwerp, Belgium, between the 1400s and 1500s (Petram, 2011). As stock markets were being established across the world, the Johannesburg Stock Exchange (JSE) was also established in 1887 during the gold rush. The JSE is Africa's largest stock exchange (Alam, Uddin and Taufique, 2017). The JSE provides access to primary and secondary financial markets, which consist of various securities that are attributed to the post-trade and regulatory service (JSE, 2014). The JSE is viewed to be the first choice for investors wanting to invest in the leading financial markets in South Africa (SA) and the African continent (Noakes and Rajaratnam, 2016). In 1963, the JSE joined the world federation of exchange and in 2001 the future exchange and the yield x was developed (Fire and Staunton, 2002). This was later followed by the alternative exchange in 2003 and the bond exchange of SA in 2009. The JSE is viewed to consist of five financial markets, namely equity, interest rate, commodity, financial and bond markets (Adam and Tweneboah, 2008).

As in any other market, economic shocks affect the daily running of financial markets. However, when one referrer to capital markets, such changes result in an increase or decrease in listed stock prices (Asteriou and Spanos, 2019). For example, the New York Stock Exchange (NYSE) was severely affected during the Great Depression of 1920. During this period, low interest rates enticed borrowing by individuals, which resulted in more significant investments in the stocks listed on the NYSE (Romer, 1990). The low interest rates caused an over-investment on the NYSE, which resulted in its crash (Carlson, 2007). Similarly, the 2008/2009 financial crisis, which resulted in a collapse of several stock markets across the globe, emanated from the poor macroeconomic management (Neaime, 2012).

The 2008/2009 financial crisis is one of the most significant economic disasters since the Great Depression of 1920 (Bordo, 2008). The implementation of the macroeconomic policy in the

1970s, which forced banks to reduce their credit requirements for low-income households, was the main contributor to the financial crisis as it created a market for subprime mortgages and allowed investors to gain easy access to capital, which elevated the amount of capital invested in the dot-com bubble (Schularick and Taylor, 2012). The excessive capital resulted in subprime lending failures and created a liquidity contagion in the banking system, which inevitably resulted in the financial crisis. Due to failed macroeconomic policies and alterations of macroeconomic variables, the financial crisis spread through the financial sector and later infiltrated other sectors as investors moved their investments (Purfield and Rosenberg, 2010). The JSE was affected tremendously as the prices of all indices fell, which caused a decrease in investor participation due to limited access to capital (Baxter, 2009). It is essentially noted that macroeconomic factors played a crucial role in the Great Depression and the financial crisis, which affected each sector differently, especially capital markets.

The SARS-COV-2 outbreak, also known as the COVID-19, which had compelled countries to lockdown/shutdown their economies as a containment measure, extensively influenced global economies and the functioning of the financial market (Goodell, 2020; Baker, Bloom, Davis, Kost, Sammon and Viratyosin, 2020). The national lockdown of countries restricted interpersonal movement, which prevented all sectors of the economy from operating (Goodell, 2020). In the full restriction on excess to China, the operation of the global supply chain was drastically interrupted. Companies throughout the world relied on inputs from China had experienced contractions in production (Sansa, 2020). More importantly, the distortion of production patterns caused by panic amongst consumers and firms created market anomalies (McKibbin and Fernando, 2020). Global capital markets responded to these drastic changes. Hence, global stock indices plunged (Zhang, Hu and Ji, 2020). In a world that is strongly connected, the global halt of economic activity resulted in global economic and capital market distress.

Capital markets play a crucial role in the world economy (Flannery and Protopapadakis, 2002). An active or stable capital market attract capital inflows, which in turn elevate economic growth. Economic agents participate in capital markets to earn returns that are consistent with their investment decisions, which are either a risk-averse or risk-preferring strategy (Kuhnen and Knutson, 2005). According to Knetter and Prursa (2003), economies are subject to stochastic shocks that influence the behaviour of the economy. The economic behaviour, in turn, determine returns on the capital markets and thus agents' investment decisions (Flaschel,

Flaschel, Franke, Semmler and Day, 1997). It is standard course that macroeconomic factors affect stock index returns, as several studies validate such a statement (Wambua and Ochieng, 2019; Bahloul, Mroura and Naifar, 2017). The JSE responded positively to changes in domestic and international interest rates. However, changes in SA inflation rate, rand/United States (US) Dollar exchange rate and SA long-term interest rate affected the JSE negatively (Naicker, 2017). The concluding remarks showed that capital markets are indeed affected by macroeconomic fluctuations and the effect either increased or decreased stock prices.

When key macroeconomic factors such as inflation (consumer price index (CPI)), industrial production, real effective exchange rate (REER) and interest rates fluctuated in the economy, they influence conditions of the equity markets. The direction of changes in the equity market conditions are contingent upon the nature of macroeconomic fluctuations. Changes in the equity market are usually associated with two terms, namely a bull and bear market. According to Chauvet and Potter (2000, p. 90), "*the bull market corresponds to periods in which market prices are generally increasing, whereas the bear refers to periods in which prices are declining*". In order for a market to be considered a bull and bear market, the increase/decrease in market prices must be around 20 or 25 percent (Pagan and Sossounov, 2003). To understand the function of capital markets and how bull and bear conditions arise, one needs to understand the efficient market hypothesis (EMH), as it explains the link between macroeconomy and stock markets, in addition to capital market efficiency.

The EMH by Fama (1965) is of the view that stock prices reflect all available information about current and future events. There are three versions of EMH. 1) A weak-form efficient market: all historical market data is contained in the current price of the stock. 2) Semi-strong form efficient market: all information is reflected in the current price of the stock and, therefore, it is impossible to use fundamental analysis to gain new information to earn excess returns. 3) Strong form efficient market: all information is contained in the current stock price, whereby it is impossible for investors to use insider information to beat the market (Malkiel, 2003). Given these forms of EMH, the semi-strong form efficient market state that if a capital market is semi-strong efficient, then macroeconomic fundamentals cannot be used to predict the stock market returns, as the stock prices already reflect macroeconomic fundamentals (Ferson, Heuson and Su, 2005). On the other hand, the weak-form efficient version illustrate that macroeconomic fundamentals can be used to predict the stock market returns (Ferson et al.

2005). Enowbi, Guidi and Mlambo (2010) found the SA stock market followed the random walk process, which confirms weak-form efficiency.

Despite EMH being widely used to explain how capital markets behave, there exist a debate where few studies (Mobarek and Fiorante, 2014; Ntim, Opong, Danbolt and Dewotor, 2011; Asiri, 2008) find that macroeconomic fundamentals play a role in explaining capital markets, which suggest capital markets are weak-form efficient. On the contrary, Khan and Ikram (2010), Hussin, Ahmed and Ying (2010) and Von Gersdorff (2009) argue that macroeconomic fundamentals did not explain the capital markets, which suggest capital markets are semi-strong efficient. Given the conflicting views, the debate surrounding EMH still prevails. However, the new debate surrounding EMH also suggest that the occurrence of efficiency and inefficiency tend to alternate with bull and bear markets in what is known as changing market conditions. This theory of alternating efficiency and inefficiency periods is known as the adaptive market hypothesis (AMH). Thus, under the AMH theory, the effect of macroeconomic fundamentals on stock market returns is also expected to change with the market conditions (bull and bear periods). A study conducted by Balcilar, Gupta and Kyei (2015) supported the presence of the AMH in the SA stock market as it found that the capital market of SA is inefficient, therefore, excess returns can be earned by investors.

The linear relationship is researched extensively as oppose to the nonlinear relationship, which comprise of changing market conditions (Toniok, 2017; Misra, 2018; Bogdan, 2019). Many scholars use different sectors of the JSE to test the relationship between macroeconomic variables and stock index returns (Gupta and Reid, 2013; Hackl and 2016; Rassool, 2018). The findings are in line with the general conclusion that there exists a linear relationship between selected macroeconomic variables and stock index returns (Naicker, 2017). However, the linear effect of macroeconomic variables on capital markets tend to vary across sectors in the capital market. Some sectors benefit positively from the fluctuation in macroeconomic variables, whereas some are affected negatively by the same macroeconomic variables. Naicker (2017) demonstrates the varied effect, changes in US interest rate, SA CPI and SA short-term interest rate affected the JSE All-Share Index returns positively. However, the same macroeconomic variables affected the Resource 10 Index returns and the Industrial 25 Index returns negatively. In contrast, the Financial 15 Index returns showed a positive effect on changes in the US interest rate and the SA long-term interest rate affected all sectors negatively (Naicker, 2017).

In line with the linear effect, there is also a nonlinear influence experienced on the JSE, as Davies (2013) showed that the JSE experienced changing market conditions. During the period January 1997 to January 2008, the returns of the market were in a general uptrend (bull market) and from December 2007 to August 2009, in a decline phase (bear market). The alternating market conditions show that the JSE is characterised by bullish conditions as the bullish trend lasted for 99 months as opposed to the bearish trend that lasted for 54 months (Davies, 2013). Moreover, macroeconomic factors affect the market differently in bull and bear conditions. During a bearish period, US inflation, US short-term and long-term interest rates influenced returns in a bearish period as opposed to the bullish period. In contrast, industrial production and REER influenced returns in a bullish period as opposed to a bearish period (Bredin and Hyde, 2000).

The findings by Davies (2013) and Bredin and Hyde (2000) refute the notion that since the formation of the JSE in 1887, it had not experienced changing market conditions, therefore, should be classified as an efficient market as proposed by the EMH. Secondly, it is evident in the literature (Ibrahim and Aziz, 2003; Ratanapakom and Sharma, 2007; Abugri, 2008) that a linear relationship exist between macroeconomic variables and stock index returns. However, one did not accept the notion that a linear relationship could have persisted under changing market conditions as the advocation for non-linearity was momentous. This is supported by the findings of Perez-Quiros and Timmermann (2000), Longin and Solnik (2001), Ang and Bekaert (2002), Bredin and Hyde (2005) and Guidolin and Timmermann (2003, 2005). The empirical evidence on the non-linearity suggest the debate surrounding EMH and the type of relationship that exist still prevails.

It is evident in the study conducted by Naicker (2017) that the JSE is affected by SA macroeconomic factors such as CPI, industrial production, short-term and long-term interest rates and REER, where such an effect tends to vary across JSE sectors. However, to what extent the JSE and JSE sectors are affected by fluctuating macroeconomic fundamentals under bull and bear markets is not known. Moreover, the bulk of research in this area focuses on industrial economies with little emphasis placed on less developed countries, which are more vulnerable to macroeconomic shocks/instabilities (Napolitano 2009; Jareño and Negrut, 2016; Jareño, Escribano and Cuenca, 2019). Further research in the emerging market, such as the JSE, is said to shed more light on how stock markets respond to macroeconomic variables in different market conditions.

1.2. Problem Statement

The fluctuations of macroeconomic factors in emerging markets contribute either positively or negatively to investment decisions (Chen, Roll and Ross, 1986). Exchange rates, economic growth and inflation are some of the macroeconomic factors that fluctuate over time. In the SA context, these macroeconomic variables fluctuate daily and are influenced by most practical cases of macroeconomic policy adjustments and less sensitive cases such as a speech by the president of a country (Malkiel, 2003). In addition to fluctuating macroeconomic factors affecting the economy of a country, they also affect the performance of the aggregated stock market (Goodnight and Green, 2010). The crash of the dot-com bubble of 2001 and the housing bubble of 2008 demonstrate such effects. The crash of both bubbles affected stock markets extensively as investors withdrew from the market due to fear and greed to sell overpriced shares (Doyran, 2016). It is, therefore, essential to understand the effect of macroeconomic factors on stock market returns—since these are key to investors' decision-making processes. Failing to understand this link may result in significant losses to investors, which inevitably result in investors withdrawing from capital markets and the formation of bull and bear markets (Moolman and du Toit, 2005). However, the extent to which the effect is more severe in bull or bear conditions is not known.

In addition to fluctuating macroeconomic variables affecting the overall stock market, they also tend to influence the disaggregated stock market differently, where one sector of a stock exchange could benefit from a change of macroeconomic variables in a given market condition (bull or bear market condition). In contrast, the other sector may not benefit from the same fluctuating macroeconomic factor. The 2008/2009 financial crisis that started in the financial sector and ended up affecting other sectors as investors moved their funds is one example of the varied effects among sectors of a stock exchange (Reinhart and Rogoff, 2008). The financial crises started in the financial sector and moved through each sector of the US capital market. However, it also went beyond the US as it infiltrated into various capital markets around the world, causing them to collapse, which inevitably affected the functioning of the world economy (Jiang, Yu and Hashmi, 2017). It is, therefore, essential to understand how these macroeconomic factors affected each sector as there is no clear explanation as to what is experienced across sectors due to the ongoing debate surrounding the linear and nonlinear relationship, between macroeconomic fundamentals and stock market returns. It is evident from the academic front that there is no common understanding as to how macroeconomic fundamentals impact each sector of capital markets, especially under changing market conditions. The response of stock market returns to changes in macroeconomic factors under changing/switching market conditions has, therefore, not been thoroughly investigated, especially in the case of South Africa and other emerging economies with a high level of macroeconomic uncertainty.

1.3. Research Objectives

The study aims to analyse the effect of macroeconomic variables on the returns of the JSE selected sectors in the presence of different (bull and bear) market conditions.

The specific objectives of this study entail the following:

- To compare how the overall JSE and its selected sectors respond to the changes in macroeconomic factors in bullish market condition;
- To determine which macroeconomic variables, affect the aggregated and disaggregated JSE returns under bearish condition; and,
- To determine the levels of bull and bear market conditions across the JSE sectors.

1.4. Justification and Significance of the Study

There exist intentional studies that considers the nonlinear relationship between macroeconomic factors and stock market returns (Bredin and Hyde, 2005; Guidolin and Timmermann, 2003, 2005; Longin and Solnik, 2001). However, in the SA context, the nonlinear relationship between macroeconomic factors and stock market returns, concerning the changing market conditions had not been investigated. The current study is unique in the sense that it considered disaggregated stock returns and compared the influence of macroeconomic factors on stock returns in different market conditions, which brought a new dimension to the SA literature as past studies did not consider these. The findings of the study are significant as they elevate the knowledge and responsive nature of investors, portfolio managers, researchers, government policymakers and individuals who have an interest in the given field of study. Investors and portfolio managers are able to make correct alterations to investment portfolios when macroeconomic fluctuations occur in capital markets, as the study provides evidence on how macroeconomic fundamentals alter stock index returns in changing market conditions. It also assists policymakers in making the correct alterations to macroeconomic variables, so the effect is not substantial on the economy of SA.

1.5. Methodology Scope

The investigation of the primary and secondary objective of the study entail incorporating a regime switching model. The model is relevant as bull and bear market conditions alternate frequently and occur at different time periods. Hence, the empirical model is needed to cater for the switching mechanism proposed by changing market conditions. The study uses the Markov regime-switch model of conditional mean with constant transition properties. The model is frequently used in empirical studies, which analyse bull and bear market conditions and has been proposed to be the most relevant model in achieving the objectives of the study (Moolman, 2004; Napolitano, 2009; Cifter, 2017). The variables that is used in the estimation of the empirical model comprise of monthly closing prices of one sector-based index and six industry-based indices. The macroeconomic variables include the monthly inflation (CPI) rate, industrial production rate, short-term interest rate, long-term interest rate, money supply (M2) and REER.

1.6. Delimitations of the Study

It is noted in previous studies that there exists nonlinear dependency between JSE stock market returns and macroeconomic variables (Bonga-Bonga and Makakabule, 2010; Cifter, 2015, 2017). Thus, the study did not test for nonlinearity as previous studies confirm nonlinearity exists between the series of interest. The study is limited to two regimes, which include bull and bear market conditions. This is done in accordance with studies by Bonga-Bonga and Makakabule, 2010 and Abadi and Ismail (2016). Moreover, all JSE indices and macroeconomic variables that are presented in the empirical literature could not be used in the study. Hence, the study selects the most relevant JSE indices and macroeconomic variables, which affect the SA economy.

1.7. The Organisation of the Study

The given study is organised as follows: chapter 2 examines the theoretical and empirical literature surrounding the relationship between stock market returns and macroeconomy. The chapter commences with various theories that dictates the underlying relationship and concludes with a review of empirical studies that have considered the linear and nonlinear relationship. After that, chapter 3 provides a detailed description of the data and the empirical model utilised in the study. The findings underpinning the empirical model are outlined and a discussion in this regard is presented in chapter 4. Chapter 5 provides a detail synthesis of the findings as well as the limitations and necessary recommendations.

1.8. Chapter Summary

This chapter commences with the background regarding the relationship between macroeconomic factors and stock market returns. It provides an in-depth discussion regarding the establishment of the first international stock exchange and then narrows down the discussion to the SA stock exchange. It further elaborates upon the financial theories that dictates the reaction of stock market returns to fluctuating macroeconomic factors and the continuous debate that prevails. The problem statement is then highlighted, which formed the basis for the study and the research questions is alluded to. Thereafter, the justification and significance of the study is conducted, which provides a detailed discussion as to why such a study is relevant and context specific. The methodology scope, limitations and the organisation of the study is then presented. It entails enhancing the readers' knowledge regarding the specification of the empirical model used in the study, limitations that exist and how the study is outlined and conducted. The next chapter presents a more detailed discussion on the financial theories that explain the relationship between macroeconomic variables and stock market returns and reviews international and local studies regarding such a relationship.

CHAPTER 2: THEORETICAL AND EMPIRICAL LITERATURE REVIEW

2.1. Introduction

The financial sector of any country was known to be a considerable identifier of economic growth. It was a common understanding among individuals that stock market returns of a specific equity market contained essential evidence of the economic wellbeing of a country, which served as a critical market identifier in a country. Several academics such as Das and Megaravalli (2017), Badullahewage and Jayewardenepura (2018) and Keswani and Wadhwa (2019) have considered the shared understanding by incorporating a series of methods of analysis contained in the literature. Whether macroeconomy affected stock market returns or not, had been considered at alternating periods across various countries. The results of such tests among the earlier academic papers had shown that the concluding findings may alternate due to attributes associated with the economy of a single country. The direction of the examined relationship between stock market returns and macroeconomic factors alternated with each economy of a country. Moreover, the majority of the findings were consistent with theoretical expectations.

It was, therefore, evident that the study of the effect of macroeconomic variables on stock market returns was essential for market participants who have an interest in listed securities. Stock prices were directly affected by macroeconomic fluctuations, therefore, affected investors returns. The theoretical and empirical literature of the study, therefore, identified the position of the relationship, which assisted market participants in making correct alternations to portfolios when macroeconomic fluctuations were said to occur.

The fundamental aspect of the following chapter explores the theoretical background and reviews the existing literature evident in the specific field of study, which encompasses both local and international evidence. The segregation of this chapter is done in two parts. First, a theoretical background is elaborated upon, which included various theories and, secondly, empirical evidence is analysed, which provided a detailed engagement with the literature. The empirical literature is separated according to the linear and nonlinear literature that existed for the relationship between macroeconomic variables and stock market returns. Moreover, the literature is further segregated according to international and SA studies. The separation of the literature is done to determine the gap in the literature, which allowed for the following study.

2.2. Theoretical Justifications

The following section commences with a detailed discussion that involved the theoretical basis surrounding the relationship between stock prices and macroeconomic factors. Herein, EMH is first identified, which determined the effect it has on stock prices and the ability of market participants to earn excess returns. After that, the behavioural finance theory is examined to determine why investors attributed irrational behaviour, thereby implying that capital markets are inefficient. Following this, the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) are identified and a discussion takes place whereby the reasons surrounding the contestation of each theory are considered.

Moreover, the linear relationship proposed, which exists between stock prices and macroeconomic variables by the theories mentioned above is elaborated upon in great detail. Given the weakness associated with EMH, CAPM and APT due to the restrictive nature of the underlying assumptions associated with each theory. The AMH is reviewed, which showed that a nonlinear relationship exists between stock market prices and macroeconomic factors. Moreover, it enabled market participants to earn excess returns due to irrational behaviour and changing market conditions. Lastly, a concluding paragraph, which contains a synthesis of the import findings of each theory and the effect it is said to have on stock markets is communicated.

2.2.1. The Efficient Market Hypothesis

The EMH was established by Fama (1965) who is of the view that capital markets are incredibly efficient as they reflect all available information regarding a stock market or any individual stock. There existed many market participants that analysed securities, a large number of competing investors who attempted to adjust the price of a stock and new information arrived randomly (Huang, 2019). EMH is, therefore, based on three assumptions, which gave rise to three versions of EMH, namely a weak-form efficient market, semi-strong form efficient market and strong form efficient market (Malkiel, 2003). Of the three versions of EMH, the semi-strong form efficient market illustrated that macroeconomic fundamentals did not allow for the prediction of stock prices; hence, a linear relationship existed between macroeconomic factors and stock market returns. However, the weak-form efficient version illustrated that macroeconomic fundamentals can be used to predict the stock market price. If such is true, then there also should exist a nonlinear relationship between stock market prices and macroeconomy (Ferson et al. 2005).

The linear relationship, therefore, made it impossible for market participants to use technical analysis, charting and fundamental analysis to earn over and above the returns that can be obtained by holding a randomly selected portfolio. As in an efficient market, new information is fully reflected in the stock price and is instantly known by various market participants as the competition that existed among portfolio managers and investors to earn positive returns was substantial (Rossi and Gunardi, 2018). The inability of market participants to earn excess returns was due to the random walk process, which formed part of the foundation of EMH. This random walk process was characterised by a price series, where any additional changes in the price of a stock demonstrate random and independent movements from past prices.

2.2.2. Behavioural Finance

Since the formulation of EMH, traditional finance had attempted to use this hypothesis to explain that market participants are rational. Therefore, any new information regarding a stock is fully reflected in the stock price, which result in markets being efficient. According to Sewell (2007, p.1), "behavioral finance is the study of the influence of psychology on the behavior of financial practitioners and the subsequent effect on markets". The formation of behavioural finance by Tversky and Kahneman in 1974 is seen as one of the major critics of EMH, as the theory postulated that market participants are not always rational and they rarely behave according to the assumption made by traditional finance, therefore, making markets inefficient (Kishore, 2004).

Investors are not always rational as they tend to base their investment decisions on ad hoc heuristics, therefore, making markets inefficient as it led to cognitive biases (Subrahmanyam, 2008). There has been a growing interest in stock markets. However, no evidence suggested that investor sophistication had increased as it was found that the tendency to value stocks on ad hoc heuristics had since increased (Hirshleifer, Subrahmanyam and Titman, 2002). The ad hoc heuristics clearly showed that market participants were since using irrational behaviour in the form of emotions and beliefs to make profound investment decisions. The irrational behaviour by market participants promoted capital market inefficiency, whereby the study of macroeconomic fundamentals to earn excess returns was pre-eminent. Behavioural finance, therefore, suggested that macroeconomic factors did influence stock market returns and if such were not correct, capital markets would be efficient, therefore, preventing the ability to earn excess returns, which is contrary to the behavioural finance theory (Ap Gwilym, 2009). The inability of traditional finance theories to explain such behaviour had resulted in the establishment of behavioural finance.

To identify how risk and return was identified theoretically based on the assumption that capital markets are efficient and inefficient, the CAPM and the APT were identified and examined. These theories suggested that macroeconomy took the form of a single risk factor in CAPM and multi-risk factor in APT. The macroeconomic risk factor was said to affect the pricing of stocks in equity markets, which was undiversifiable due to effect of being unobservable.

2.2.3. The Capital Asset Pricing Model

The CAPM was established by Sharpe (1964), Linter (1965, 1969) and Mossin (1966). The basis surrounding the establishment of CAPM was to determine how the expected return of a single asset in a market portfolio was influenced by risk. This model was said to be a single risk asset pricing model, which identified sources of risk for a single capital asset in the form of beta (Fama and French, 2004). Given such observations, a linear relationship existed between the expected return of a market portfolio and risk factors, therefore, suggesting the absence of acquiring excess returns (Jacoby, Fowler and Gottesman, 2000).

The formulation of the market portfolio held by investors was done on the premises of the assumptions proposed by CAPM and the alignment of the theoretical basis of portfolio finance. The assumptions of CAPM were conformed to four key determinants, namely: 1) investors maximise their level of expected return by minimising the risk of the portfolio, which essentially meant that they are risk-averse. 2) capital markets were efficient, which contains no taxes and transaction costs. It suggested that all types of information proposed by EMH were available to market participants, which allowed market participants to acquire and lend capital at the risk-free rate. 3) investors' strategies are proposed to be similar for each investor. Hence, the choices made to acquire a particular asset are identical, therefore, not catering for risk-taking market participants. 4) investors contained identical correlations between asset returns, the standard deviation of returns and estimates of anticipated returns (Perold, 2004).

Portfolio theory provided an identification that market participants selected portfolios that were situated on the efficient frontier, therefore, known as mean-variance-efficient. Based on this, CAPM assumed that all portfolios were mean-variance-efficient and contained along the efficient frontier. Therefore, implying that the expected return of a single asset would attribute a linear relationship with risk factors (fluctuating macroeconomic factors). Where the latter was accurate, the former was not true as it implied that to maintain equilibrium in the asset market, the relationship between risk and the anticipated return of efficient portfolios was identical for the market as well. Given the absurd assumptions by CAPM, the theory had faced much criticism, as Roll and Ross (1984) showed in the form of the APT why such was not accurate. This was examined next in great detail.

2.2.4. The Arbitrage Pricing Theory

The APT was established by Ross and Ross (1984) on the premises of the contestation of the proposed limitations of the systematically distribution of returns and quadratic preferences (Sharpe, 1964). The basis of the systematic distribution of returns as proposed by the CAPM was in the form of a single factor variable needed (beta) when one wants to measure the riskiness of a single asset in a market portfolio. However, APT refuted such a notion as it stated that the riskiness or average long-term return of an asset was dependent upon the unobservable changes of economic factors, namely inflation, risk premiums, industrial production and the term structure of interest rate slope (bonds) (Dlamini, 2017). The basis of such an argument put forth by APT was solely dependent upon the notion that where CAPM proposed the single factor requirement in the form of beta, such a beta incurred alternative sensitive reactions to the systematic and unsystematic factors. Hence, the single factor measurement of risk was contested by APT.

Moreover, APT recognised that a wide variety of factors influenced the daily closing prices of listed securities. However, it tended to focus on factors that influenced the overall fluctuations of portfolios, which included both systematic and unsystematic factors (Dlamini, 2017). The systematic factors were also considered as unanticipated effects, which are unobservable by investors and were not considered by investors when determining the expectations of the return of individual assets, therefore, not incorporated in asset prices (Ross, 1976). This type of risk is considered to be undiversifiable as it included macroeconomic factors that determine the expected and actual returns of a portfolio and in essence, the returns of a listed stock. According to the theory, it was given to be that a linear relationship existed between the expected return of an asset and the covariance with macroeconomic variables, in this instant the systematic factors (Junkin, 2011).

These macroeconomic variables were known to flatulate; however, the direction and magnitude of the deviation from its real value was not known. Therefore, investors were unable to diversify such risk but merely protect the portfolio from such shocks by imposing strategies to prevent loss inherited (French, 2017). It was also noted that where unanticipated events were presented there should be anticipated premises in the form of unsystematic factors. However, this type of factor was not essential to APT as these factors were always considered by investors and incorporated into the return of a stock or assets due to the risk being diversifiable and virtually eliminated by investors (Roll and Ross, 1984). Therefore, it did not affect the premises of the portfolio returns or asset price to a greater extent than the macroeconomy.

The notion of EMH, CAPM and APT had shown that a linear relationship existed between the returns of a particular asset and macroeconomic factors. Hence, the premises of earning excess returns were, therefore, non-existent. However, such had been continually contested by the emerging discipline of behavioural economics and finance, which argued that markets are not efficient but are instead driven by fear and greed. Hence, a nonlinear relationship should be observed (Lo, 2004). Many scholars share such a thought as empirical evidence had shown that capital markets experience changing conditions, which allowed market participants to earn excess returns. The basis of this evidence was in the form of the AMH.

2.2.5. The Adaptive Market Hypothesis

Over the past decade, traditional finance had relied on EMH as one of the essential hypotheses, which explained market conditions and investor behaviour. However, such a notion was starting to dissipate since Lo (2004) formulated the AMH. The basis of the hypothesis involved a revolutionary outlook of behavioural economics and it included principles such as competition, reproduction, mutation and natural selection (Ghazani and Ebrahimi, 2019). The argument proposed by AMH was that the violation of the rationality of EMH and the inconsistencies of market efficiency as a result of AMH are indeed correct and consistent with an evolutionary model of individuals adapting to changes in an environment through sample heuristics (Kumar, 2018). According to AMH, the efficiency of capital markets and the performance of the business, investment products and industries were determined by the evolutionary forces that have an impact on financial institutions and market participants. Many critics of AMH had raised the question that it was rather abstract and qualitative. However, they failed to understand that AMH contained serval implications that were astonishing yet concrete concerning financial activities.

The first implication was that if there existed a relation between risk and reward, then it was improbable that it remained constant over time. According to AMH, the relation between risk and reward was determined by preferences and size of market participants in a given capital market and as these factors varied with time, then any risk/reward relation was affected (Lo, 2004). The second implication was seen to be contrary to EMH, as it was proposed that arbitrage opportunities did exist as time varied. As long as liquid markets existed, then from a revolutionary perspective there existed profit opportunities. As market participants exploited such favourable circumstances, these profit opportunities disappeared. However, new opportunities were consistently being created as investors entered and exited the market (Gyamfi, 2018). The third implication was also seen to be contrary to EMH and implies that under AMH investment, strategies may fall for a period; however, as the environment becomes more favourable for market participants, it returns to profitability.

These implications, therefore, explained the adapting relationship between stock markets and macroeconomic variables as the relationship between macroeconomic fundamentals and stock market returns must be nonlinear. If a linear relationship was observed, then no arbitrage opportunity was taken, which refuted the basis of AMH. It was, therefore, reasonable to conclude that AMH demonstrated that macroeconomic fundamentals did indeed influence stock index returns and such influence was nonlinear as proposed by the various implications. Moreover, AMH showed that the alternating efficiency of stock markets was the key attribute to changing market conditions (Lo, 2004). Macroeconomic variables had an alternating affect under a bullish and bearish market. Thus, the affect macroeconomy had on stock market returns in an upper market condition was not the same in a lower market condition due to stock market returns performing differently under each market condition. AMH, therefore, implied that market participants could earn excess returns as markets are not always efficient due to the behaviour of various market participants and changing market conditions.

2.2.6. Conclusion

At the onset of the above section, the academic proposed to identify theoretical justifications surrounding the pricing of capital assets, in such case, share prices. The theories that were identified were given to be the EMH, behavioural finance, CAPM, APT and AMH. The derivation of each model, as well as the strengths and weaknesses, were considered. The synthesis of the relevant theories was as such:

At the start, EMH was a vital theory when explaining how capital markets were said to operate as it identified assumptions that dictated the efficiency of capital markets. It gave way to three types of market forms, of which the semi-strong form efficient market justified the apparent linear relationship between stock market prices and macroeconomy, as it showed that macroeconomic fundamentals could not be used to predict stock prices. However, the weak-form efficient market demonstrated the total opposite and in such a case, it was invertible that a nonlinear relationship existed. Given the conflicting views, the debate surrounding the type of relationship that existed between stock market prices and macroeconomic fundamentals still prevails. After that, the behavioural finance theory determined the behaviour of market participants. As opposed to EMH, behaviour finance suggested investors were not always rational as they tended to base their investment decisions on ad hoc heuristics, therefore, making markets inefficient as it led to cognitive biases. The inefficiency of capital markets gave rise to investors earning excess returns through the study of systematic and unsystematic risk factors, of which macroeconomy was one of them. As a result, behaviour finance supports the existence of a nonlinear relationship between stock market returns and macroeconomic factors.

Following this, CAPM and APT were elaborated upon to determine how risk and return of a single asset were determined. The assumptions associated with the model gave rise to the systematical distribution of returns and quadratic preferences. This led to CAPM formulating a calculation by which the risk of a single asset was estimated with reference to the market risk. Moreover, it allowed the expected return to be determined. CAPM was said to focus on unsystematic risk factors when determining the expected returns as systematic risk (macroeconomic factors) was invertible and undiversifiable in nature. Given the assumptions of CAPM, the practicality of the model was questioned, which led to APT being formulated. The APT had similar qualities as CAPM. However, it tended to focus on the contestation of the single risk property associated with CAPM. Thus, it provided a key advantage over CAPM, as it had developed a calculation of determining more than one source of risk associated with asset prices. It focused on the systematic forces as it found that it contains multiple forms of risk, hence APT was known as the multi-risk asset pricing model. The systematic risk was also considered to be macroeconomic fluctuations as it was unobservable and contributed to the pricing of assets. However, it contained issues in the methodology surrounding the estimation of the model.

The shortcomings of EMH, CAPM and APT gave rise to the AMH. At the heart of this model lies the fundamental principle of a revolutionary outlook concerning behavioural economics. The theory, which was supported by behavioural finance, showed that market participants adapted to changes in an environment through sample heuristics. This led to irrational behaviour, therefore, making markets inefficient, which contributed to the ability to earn excess returns. The implications are such that it explained the adapting relationship between stock markets and macroeconomic variables as the relationship between macroeconomic fundamentals and stock market returns was nonlinear. Given the basis of this theory, it formed part of the essential theoretical justification needed to validate the study.

2.3. Empirical Evidence

Following a seminal study by Asai and Shiba (1995), the linear relationship between macroeconomic variables and stock market returns had been extensively researched. However, Bonga-Bonga and Makakabule (2010) found a limited amount of empirical studies that had considered the nonlinear relationship, especially in the SA context. It was, therefore, seen in this section that the author of the study had reviewed more linear empirical literature as opposed to the nonlinear empirical literature. Furthermore, more emphasis had been placed on studies during the 2014-2019 time period. However, outside of this period, studies were considered but not to a greater extent as the former time interval. The reason for such considerations was due to the discrepancies that existed between empirical studies, as Ahmad, Abdullah, Sulong and Abdullahi (2015) note empirical evidence between macroeconomic variables and stock market returns was mixed. It was seen that some found a sanguine link (Hsing, 2011; Buyuksalvarci, 2010; Brahmasrene and Jiranyakul, 2007), while others documented an antagonised relationship (Xu, 2011; Leon, 2008; Ologunde, Elumilade and Asaolu, 2007) and others demonstrated no relationship (Saeedi and Kuhsarian, 2010; Gay, 2008; Pethe and Karnik, 2000). The reason for the conflicting findings among research studies was attributed to the diverse methodologies, periods and variables employed in these studies.

2.3.1. The Linear Relationship

2.3.1.1. The Relationship Between Macroeconomic Factors and International Markets

Maysami, Howe and Rahmat (2005) used the vector error correction model (VECM) to examine the link between macroeconomic variables and Singapore listed stock index returns. They found short-term interest rates, money supply (M2), exchange rate, inflation (CPI) and industrial production exhibited a positive and significant relationship with the Singapore All-Share equity indices, only long-term interest rates illustrated a negative and insignificant relationship with the given indices. Finding a positive link between CPI and returns contradicted other studies such as Patra and Poshakwale (2006), Boucher (2006) and Menike (2006), which found a negative link between these variables. Gan, Lee, Young and Zhang (2006) also investigated the link between macroeconomic factors and the New Zealand stock exchange using the Johansen cointegration test. They demonstrated evidence of a long-run relationship between macroeconomic variables and the New Zealand stock exchange 40 index returns. Consistent with this, Olowe, Rufus and Ayodeji (2007) found evidence of a long-run relationship between macroeconomic variables such as inflation (CPI), industrial production, money supply (M2), oil prices and interest rates and the Nigerian stock exchange returns.

Adam and Tweneboah (2008) examined the equilibrium relationship between macroeconomic variables and the Ghanaian Databank Index returns. Using VECM, they found interest rates and inflation (CPI) influenced the stock market index returns positively. Contrary to this, Sohail and Hussain (2009) found that inflation (CPI) and the three-month Treasury bill rate had a negative and insignificant effect on stock market returns. Moreover, in the long run, REER, industrial production and money supply (M2) had a positive and significant relationship with stock index returns. Similarly, using the Johansen Jules procedure, Antonios (2010) found a positive and significant relationship between the German stock market returns and economic growth. This was consistent with theory as a stock market tends to assume power until the feedback mechanism comes into effect. A crucial discovery was that gross domestic product (GDP) was not a good proxy for growth, therefore, was condemned by academics.

Oskenbayev, Yilmaz and Chagirov (2011) used the autoregressive distributed lag (ARDL) model and the Johansen cointegration test to investigate the relationship between macroeconomic variables and the Kazakhstan stock market returns. The findings indicated that there existed a short-run relationship between short-term bank loans and Kazakhstan stock index returns and a long-run relationship existed for inflation (CPI) money supply (M2) and exchange rate. Consistent with this, using VECM, Hassanzadeh and Kianvand (2012), found a long-run relationship between GDP, money supply (M2), REER and the Iran stock market returns. Dos Santos, Neto, De Araujo, De Oliveira and Abrita (2013) also used VECM in examination of the relationship between macroeconomic factors and the Brazilian stock market returns. They found a positive relationship between the stock market returns and exchange rate, interest rate and industrial production. This showed that foreign investors' perception of the risk of the index was high.

Kirui, Nelson, Wawire and Perez (2014) evaluated the relationship between macroeconomy and the Nairobi stock exchange limited. Using the Engle-Granger test and the threshold generalised autoregressive conditional heteroscedasticity (TGARCH) model, they found exchange rate had a positive relationship with the stock market returns. However, exchange rate, interest rate and GDP were asymmetric to the impact of news, with the persistence of leverage effects. In contrast, Khodaparasti (2014) used the variance model, which found a linear relationship between the Iran stock market returns and inflation (CPI), exchange rate, industrial production index and money supply (M1). However, the industrial production index had a more significant effect on the stock returns of Iran than that of inflation and exchange rate. Having found a linear effect between stock market returns and inflation (CPI), exchange rate, money supply (M1) and industrial production was consistent with a study by Bahar Moghadam and Kavaruei (2012).

Cankal (2015), used the structural vector autoregressive (SVAR) model and attempted to test whether the theoretical basis surrounding macroeconomic factors and stock market returns was correct in the Turkish economy. The findings showed that the Borsa 100 Index returns were significantly influenced by inflation (CPI), interest rate and exchange rate fluctuations. This was consistent with the theoretical literature. Contrastingly, Pratama (2015) found the Indonesian stock market returns were negatively influenced by interest rates and the exchange rate. However, inflation (CPI) postulated a positive relationship. The deviation in findings was attributed to the demographic transition between the two studies and the economic conditions in each country. Linck and Decourt (2016) also investigated the correlation between macroeconomic variables and Brazilian stock market returns. They found that interest rates and GDP influence stock returns of the Bovespa Index, where inflation showed no relationship with the stock market return.

Jareño and Negrut (2016) used the Pearson correlation test and graphical representations to examine the effect of inflation (CPI), GDP, industrial production, unemployment rate and long-term interest rate on the Dow Jones Index and the standard and poor (S@P) 500 Index. The findings showed that both indices evolved similarly between the 2003-2006 period, which suggested that the market was used as a leading indicator for the real economy. In addition, positive and significant coefficients for GDP and industrial production were found, whereas negative and statistically significant coefficients were seen for the unemployment rate, inflation (CPI) and interest rate. In contrast to this, using a multiple linear regression model, Toniok (2017) found the Nairobi stock exchange returns had a significant positive relationship with inflation (CPI) and interest rates. Identical findings were found in the African continent by Laichena and Obwogi (2015).

Jamaludin Ismail and Manaf (2017) examined the effect of macroeconomic variables on Singapore, Malaysia and Indonesia stock market returns. Using a panel least squares regression model, they found exchange rate and money supply (M2) influenced the returns of Islamic stock market returns extensively. Moreover, inflation (CPI) affected stock market returns negatively. Consistent with this, Ullah, Islam, Alam and Khan (2017) found exchange rate, money supply (M2) and foreign currency reserves positively influenced the south Asian association for regional cooperation (SAARC) countries' stock market returns, and inflation (CPI) attributed a negative and insignificant effect. Habib and Islam (2017) also investigated the relationship between the Indonesian stock market returns. However, using the ordinary least squares (OLS) regression, they found inflation and industrial production to have a positive effect on the Indonesian Islamic stock index returns. It was assumed that similar findings should be identified as Islamic stock returns were utilised. However, such was not the case.

In a similar study, Nikita, Balasubramanian and Yermal (2017) examined the effect of macroeconomic variables on the Indian stock market returns using VECM. They found GDP factor of both India and the US to have had influenced the Nifty 50 Shariah Index returns. Al-Abdallah and Aljarayesh (2017), also used the Johansen cointegration test to investigate the impact of the macroeconomy on the Amman stock exchange. They found interest rate and inflation (CPI) significantly influenced Jordan stock market returns, inflation (CPI) had a positive effect, interest had a negative effect and exchange rate had no effect. Consistent with this, Lee, Ng, Soon and Thou (2017) found money supply (M2), REER, industrial production and inflation (CPI) had a positive short-run relationship with the Thailand stock market returns, with only GDP demonstrating a negative relationship. Finding a positive link between inflation and returns contradicted a study by Ahmad-Sufian (2017), which found a negative link between these variables.

Badullahewage (2018) conducted a study in Sri Lanka to determine the overall impact and role of macroeconomic variables on stock index returns. Using linear models, they find inflation (CPI) and exchange rate to have a positive and significant effect on the stock returns. Consistent with this, Nijam, Ismail and Musthafa (2018) also examined the relationship between Sri-Lanka stock market returns and macroeconomy, they found inflation (CPI), exchange rate and money supply (M2) had a positive relationship with stock market returns. Kwofie and Ansah (2018) used the ARDL model to investigate the effect of macroeconomic factors on Ghanaian stock market returns. They found a long-run relationship between inflation (CPI), interest rates and the Ghanaian All-Share Index returns.

In a similar study by Khan, Khan, Ahmad and Bashir (2018), the overall objective was to determine how a given set of macroeconomic variables influenced a set of firms returns listed on a stock exchange. They estimated the OLS model and showed that interest rate and inflation (CPI) had a negative relationship with the returns of the 100 Index, whereas the exchange rate had a positive effect. Finding a negative link between interest rates and stock market returns was consistent with studies such as Humpe and Macmillan (2007) and De Sousa, Noriller, Huppes, Lopes and Meurer (2018), which found interest rates and exchange rates to have a negative and significant relationship with stock market returns of Latin America.

A study by Babajee, Ramdhany, Seetanah and Sookha (2018) was seen to deviate from the generalised conducted studies as the academics extended their analysis to emerging markets owing to the limited academic research conducted in this area. They implemented a panel regression model and found inflation (CPI) to have a positive and significant effect on the returns of the emerging markets, whereas the exchange rate was found to have a negative impact on stock returns. In contrast, Garg and Kalra (2018), found GDP, exchange rate, gold prices and foreign exchange rate to have positive coefficients. This indicated that it positively influences Sensex Index returns in the long-run, whereas inflation (CPI) and unemployment rate negatively influence the stock market index returns in the long-run. Finding a positive long-run relationship between macroeconomic variables and stock market returns was in line with a study by Misra (2018), which found a long-run relationship between industrial production, money supply (M2) and Indian stock market returns.

Josiah (2019) examined the relationship between macroeconomic variables and the Nigerian stock index returns using the Johansen multivariate cointegration test. They found exchange rate, real GDP and financial openness to have a significant positive relationship with stock index returns. However, inflation (CPI) and interest rates demonstrated a weak negative relation. In contrast to this, John (2019) also investigated the relationship between macroeconomic variables and the Nigerian stock index returns. However, they found a positive and statically insignificant relationship with the Nigerian All-Share Index returns and the exchange rate. Moreover, inflation (CPI) demonstrated a statistically positive relationship with the index returns.

Bogdan (2019) conducted a study in the republic of Croatia, where the research entailed analysing the effect of macroeconomic variables on the returns of the hospitality industry using the vector autoregressive (VAR) model. The findings were seen to generate common concluding remarks that were evident across empirical evidence, such that inflation (CPI) granger-caused stock market returns in the hospitality industry. In contrast, the impulse response function suggested that stock prices tended to react negatively to shocks, which met the expectations of the direction of the impact. Finding a positive link between inflation and returns supported other studies such as and Chen, Roll and Ross (1986) and Wong and Song (2006). Okonkwo (2019) also used the granger causality test to investigate the causal nexus between macroeconomic variables and stock market volatility in the emerging market of Nigeria. They found industrial production and exchange rates to influence stock return volatility.

In a similar study, Mawardi, Widiastuti and Sukmaningrum (2019) aimed to identify how macroeconomic variables influence the Indonesian stock exchange. Using linear regression, they found a positive relationship between inflation (CPI), industrial production and the Indonesian index returns, whereas interest rates exhibited a negative relation with the index returns. Consistent with this, a study by Ahmad, Maochun and Sattar (2019) found a negative relationship between stock returns and interest rates. However, a positive relationship was evident for exchange rate. Jareño, Escribano and Cuenca (2019) also determined if a correlation existed between macroeconomic variables and stock market returns of international countries.

Using the Pearson correlation coefficient, they found unemployment and GDP to have a positive correlation with each of the countries' stock market returns. However, inflation (CPI) and industrial production demonstrated a lower correlation.

2.3.1.2. The Relationship Between Macroeconomic Variables and Local Markets:

The first study initiated in SA can be traced back to Van Rensburg (1995) who investigated the simultaneous relationship between the JSE selected indices and macroeconomic factors. Using the OLS regression model. The findings showed that gold prices and the Dow-Jones industrial indices illustrated a positive relationship. However, a negative correlation existed between interest rates and inflation (CPI). The mining-financial indices demonstrated a positive relationship with gold price and inflation (CPI), whereas interest rates shared a positive and significant relationship with the two mining indices. Jefferis and Okeahalam (2000) criticised the research paper of Van Rensburg (1995) as the academic utilised the wrong methodology. In an attempt to rectify such inconsistencies, they also examined the effect of macroeconomic variables and the SA stock market returns using the Johansen and Juselius (1990) cointegration tests. They found that SA indices were influenced by international and domestic interest rates, exchange rates and the US interest rates.

Moolman and du Toit (2005) also tested the connection between macroeconomic variables and JSE returns. However, the academic constructed a theoretical framework by utilising the error correction model (ECM). The findings showed that JSE All-Share Index returns fluctuated due to interest rates, gold price, risk premium, exchange rates and S&P500 Index returns deviated from its real value in the economy. This suggested that returns of the JSE were influenced by macroeconomic variables. However, a conclusion under changing market conditions was not determined. Consistent with this, Hsing (2011) also investigated the relationship between JSE listed indices and macroeconomy. Using the exponential generalised autoregressive conditional heteroskedasticity (E-GARCH) model. They found the JSE index was correlated with the ratio of GDP to money supply (M2), GDP to the US listed indices and depreciation of the rand. However, the stock market returns were negatively correlated with the real interest rate, exchange rate, inflation (CPI) and the ratio of US government bond yield to the government deficit. Finding a negative link between exchange rate and stock index returns was consistent with a study by Mangani (2009), which found a negative relationship between SA stock market returns and exchange rate, inflation (CPI) and interest rates.

In a master's thesis by Afordofe (2012), the relationship between selected macroeconomic variables and JSE returns was examined. Using series autocorrelation correlograms and line graphs, they found GDP and exchange rate to have a positive relationship with the Resource 10 Index returns. However, the interest rate showed a negative relationship. Moreover, it was found that inflation (CPI) had no relationship with the stock market index returns. Finding a positive link between GDP and returns contradicted other studies such as Banda (2018), Rassool (2018), Naicker (2017), Dlamini (2017) and Hackland (2016) that found a negative link between these variables

Gupta and Reid (2013) used the Bayesian vector autoregressive (BVAR) model to determine if anticipated shocks to macroeconomic variables affected the JSE aggregated and disaggregated stock market returns. They found inflation (CPI) significantly influenced the SA stock market returns. Moreover, inflation (CPI) and the producer price index are also found to influence the returns of the aggregated and disaggregated stock market returns. However, the effect was relatively compact and occurred in the short run. In a similar study by, Muzindutsi (2013) examined the responsive nature of JSE stock market returns to exchange rate regimes by using the Pearson correlation coefficient and granger causality tests. The findings showed that the responsive nature of the stock market returns was not consistent for each exchange rate regime. However, the free-floating exchange rate system showed a significant influence on stock market returns. Also, the direction of the causality changed as the different exchange rate regimes were implemented, suggesting exchange rate regimes had a significant impact on the relationship between the JSE All-Share Index returns and the exchange rate.

Tripathi and Kumar (2014) aimed to determine if a long-run equilibrium relationship existed between inflation (CPI) and the various stock market returns of the Brazil, Russia, India, China and SA (BRICS) countries. Using the Johansen cointegration test, they found a short-term relationship between inflation (CPI) and SA stock market returns. Consistent with this, Ajayi and Olaniyan (2016) used VECM and found a positive short-run relationship between inflation (CPI) and JSE market returns. Having found a short-run link between inflation (CPI) and returns contradicted a study by Sufaj (2016), which found a negative long-run link between these variables.

Chipeta and Szczygielski (2015) used the multifactor model as proposed by the APT to determine the reaction of the JSE returns to risk factors. The results indicated that the JSE market returns were influenced by international factors, namely inflation (CPI), cyclical movements in the business cycle and exchange rate. Furthermore, the US inflation rate had a negative effect on the JSE returns and the rest of the variables had a positive impact. In contrast to this, Muchaonyerwa and Choga (2015) also investigated the relationship between the JSE returns and business cycle indicators by constructing a VECM. However, they found a positive relationship existed between the JSE All-Share Index returns and inflation (CPI), money supply (M1) and prime overdraft rate (POR).

Tripathi and Kumar (2015a) aimed to determine if macroeconomic variables influenced stock market returns across the BRICS countries. Using the ARDL model, they found the SA stock market returns had a significant negative relationship with inflation (CPI), exchange rate and interest rate. Contrary to this, Tripathi and Kumar (2015b) also examined the link between inflation (CPI) and SA Stock market returns using granger causality tests. They found a positive relationship between inflation (CPI) and unidirectional causality from stock returns to inflation (CPI). Finding a positive relationship between inflation (CPI) and stock market returns was in line with a study conducted by Shawtari, Hussain, Salem and Hwariyuni (2016), which found the SA stock market to be highly sensitive to changes in industrial production. However, inflation (CPI), money supply (M2) and exchange were given to positively influence the JSE market returns but not to the same extent as industrial production.

Ajayi and Olaniyan (2016) used VECM to examine the effect of the macroeconomy on the SA stock market returns. They found a unidirectional causal relationship between industrial production and inflation (CPI) with the JSE index returns. Moreover, inflation (CPI), interest rates and industrial production had a long-run effect on the FTSE 100 Index returns. In addition, no long-run relationship was observed for the JSE All-Share Index returns. This contradicted the findings of Sufaj (2016), which found the existence of a long-run relationship in the SA context. Gay (2016) also tested the effect of the macroeconomic variables on the BRICS countries' stock exchange by using the Box-Jenkins autoregressive integrated moving average (ARIMA) model. It was seen that the exchange rate had no significant relationship with the SA stock market returns, which suggested a weak form of market efficiency existed for all countries except for SA.

Msindo (2016) investigated the effect of macroeconomic variables on the JSE All-Share Index returns using the VAR model. The concluding remarks are such that there existed a negative relationship between interest rates and the JSE returns. The JSE returns were granger caused by short-term and medium-term interest rates. This was confirmed by the impulse response function and the variance decomposition test. Hackland (2016) also examined the relationship between macroeconomic variables and the sector returns on the JSE. Using a cross-correlation analysis, GDP was found to be positively correlated with Financials 15 Index returns and Industrial 25 Index returns. The prime lending rate was negatively correlated with each index returns, whereas inflation (CPI) was negatively correlated with the JSE Top 40 Index returns and Resource 10 Index returns. Finding a positive link between GDP and the SA stock market returns was consistent with a study conducted by Rassool (2018), which found GDP affected the Financials 15 Index returns positively.

A study conducted by Sufaj (2016) examined the relationship between the macroeconomic variable and the JSE market returns using the VAR model and VECM model. They found the SA stock exchange to have demonstrated a long-run relationship with interest rates, exchange rate and inflation (CPI). Consistent with this, Ntshangase, Mingirl and Palesa (2016) also used VAR and VECM to investigate the short-run and long-run effect of macroeconomy on SA stock market returns. They found a long-run relationship between the JSE All-Share Index returns and money supply (M3) and interest rates exchange rate. Finding a long-run relationship contradicted studies such as Ajayi and Olaniyan (2016) Chipeta and Szczygielski (2015) and Tripathi and Kumar's (2014), which found a shot-run link with the variables.

In a master's thesis, Dlamini (2017) investigated the effect of macroeconomic variables on the JSE Financial 15 Index. Using the granger causality tests, the academic found interest rate and gold prices impacted the Financial 15 Index returns both positively and negatively. It was also found that a unidirectional causal relationship from the US short-term interest rate to Resource 10 Index returns, from SA short-term interest rate to Financial 15 Index returns and from industrial production, US and SA short-term interest rate to Industrial 25 Index returns. Consistent with this, Naicker (2017) used the Johansen (1988) model and found the JSE All-Share Index to have had a significant relationship with the US interest rates, inflation (CPI) and exchange rates. However, the short-term interest rate and inflation (CPI) influenced the returns of the Resource 10 Index returns and the Industrial 25 Index returns negatively. The impulse response function showed that of the macroeconomic variables, only US interest rates, inflation (CPI), exchange rate and short-term interest rate explained the index returns.

In a similar study, Alam, Uddin and Taufique (2017) examined the sensitivity of the JSE to exchange rate fluctuations using the Engle-Granger cointegration test and the granger causality test. They found a long-run equilibrium relationship between the exchange rate and the JSE returns. However, the granger causality test showed no evidence of causality between the two variables. The findings showed that the JSE is semi-strong form efficient, which implied that investors cannot use the foreign exchange rate to earn abnormal returns. However, the academic was not able to pronounce similar findings for domestic macroeconomic variables, therefore, the efficiency of the JSE was still uncertain. Majija (2017) also determined the relationship between JSE returns and macroeconomic factors. Using the bayesian vector autoregression (BVAR) model, they found GDP, current account, US Federal reserve rate and the REPO rate to have a significant effect on the JSE returns.

Daggash and Abraham (2017) used the TGARCH model to determine the effect of the exchange rate on the JSE returns. They found the exchange rate to have a short-run positive effect on the index returns. Furthermore, a very week relationship between the volatility of the rand and returns were evident. Finding a week link was supported by Raddatz (2008), which found exchange rate volatility to have no effect SA trade flows and exports. Finding no link between volatility and the SA stock market is contrary to a study conducted by Afful (2017), which found interest rate volatility affected JSE returns.

Ndlovu, Faisa, Resatoglu and Tursoy (2018) explored the association between macroeconomic variables and the JSE returns. Using the VECM, they found inflation (CPI) and interested rates to have a positive relationship with stock prices in the long-run. However, exchange rate and money supply (M2) had a negative effect on stock prices. It was seen that a unidirectional causality was evident for interest rate and exchange rate. Similarly, Banda (2018) also used VECM to examine the relationship between the macroeconomy and SA stock market returns. They found a positive relationship between the Industrial 10 Index returns and inflation (CPI). However, the prime interest rate demonstrated a negative relationship with the index returns. Finding a positive link with inflation was consistent with a study conducted by Rassool (2018), which found inflation to influence stock market returns.

Shonhiwa (2018) aim was to explore the possibility of a relationship between macroeconomic variables and JSE sector returns. Using the VAR model and the VECM, they found, oil prices to have a negative relationship with stock index returns. Akinsomi, Mkhabela and Taderera

(2018) study was seen to deviate from the general form, as the commercial real estate returns were used to test the effect of macroeconomy using correlation analysis. They found GDP, interest rates and the unemployment rate to have significantly explained total returns of the commercial real estate in SA. However, capital returns are negatively correlated with rental growth. This suggested the real estate returns contain heterogeneity, hence the complexity attained to investigation through regression estimates. The findings showed the extent to which macroeconomic variables can influence other parts of the capital market as opposed to a single equity market.

Rassool (2018) used VECM to investigate the effect of macroeconomic variables on stock index returns. The findings showed that JSE All-Share Index returns had a positive relationship in the long-run with GDP, inflation (CPI), money supply (M2), foreign interest rate and exchange rate, whereas Resource 10 Index returns had a negative relationship with the exchange rate, long-term interest rate and foreign short-term interest rate. The Financial 15 Index returns and Industrial 25 Index returns demonstrated a positive relationship with the unemployment rate and national interest rate. Consistent with this, Banda, Hall and Pradhan (2019), found inflation (CPI) and exchange rate to have a positive and significant relationship with the Industrial 25 Index returns. GDP, interest rate and aggregate economic output had a negative relationship with the industrial share returns. Finding a positive link with the exchange rate contradicted a study by Ncanywa and Ralarala (2019), which found the exchange rate to have influenced the SA stock market returns positively. Molele (2019) also examined the effect of macroeconomic variables on the oil and gas returns listed on the JSE. Using the GARCH–GED model, they found money supply (M3) to have a positive and significant relationship with the oil and gas returns.

2.3.1.3. Conclusion on Linear Relationship

It was noted from the onset of this sub-section that there existed a large quantity of empirical literature that considered the linear relationship between stock market returns and macroeconomy. The interaction between stock market returns and individual macroeconomic factors was dictated by the geographical area and alternating economic conditions of each country. As a result, the relationship between the two factors was not consistent among each country. However, in the developed countries, the relationship between the two factors had been consistent as with the developing countries. This was owing to the above mentioned, that being the economic conditions were consistent among developed nations as opposed to developing nations. Therefore, similar findings were identified. Despite the conflicting findings among the classification of each country. At all insistences, it was found that a relationship between stock market returns and macroeconomy existed.

The relationship that existed between stock market returns and macroeconomy was either a positive or negative one. If a positive (negative) relationship was said to exist, then fluctuations in the macroeconomic variable increased (decreased) stock market returns. The variables that had been commonly used in the literature for stock market returns were the All-Share Index that was proxied for the stock market and sector-based indices. However, for the macroeconomy, the short-term and long-term interest rate proxied by the three-month treasury bill rate and the ten-year government bond yield respectively, money supply (M2), industrial production, REER, GDP, exchange rate in terms of the domestic currency as of the US dollar and the inflation rate given by CPI. Moreover, it was found that only money supply (M2), GDP and industrial production positively influenced returns (Khodaparasti (2014), Hackland (2016) and Rassool (2018)) and exchange rate, inflation (CPI) and interest rates negatively affected equity returns (Jareño and Negrut, 2016; Naicker 2017; Banda 2019).

However, there have been some conflicting findings, such that Maysami et al. (2005) found inflation to have a positive relationship with stock market returns, whereas Mohammad (2017) found a negative relationship. The same was evident for REER, whereby, Sohail and Hussain (2009) found a positive relation and Hassanzadeh and Kianvand (2012) found a negative relation. The conflicting views were attributed to the methodology in use and the sample period.

Most of the international and local studies that considered the linear relationship between stock market returns and macroeconomic factors used the same empirical model to examine the desired relationship. The Johansen and Juselius (1990) procedure was administered (Gan et al., 2006; Hasanzadeh and Kianvand, 2012; Tripathi and Kumar, 2014; Choga, 2015; Claver et al., 2019). This procedure consisted of firstly estimating either the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) (1992) test, Phillips and Perron (1988) (PP) test and the Augmented-Dickey Fuller (ADF) (Dickey and Fuller, 1981) test of stationarity. Thereafter, when data were found to be stationary, the short-run and long-run relationship between stock market returns and macroeconomic factors were tested. This included the granger causality (short-run relationship) test, Engle-Granger and the Johansen cointegration (long-run relationship) test.

Lastly, ECM and VECM were regressed to determine if the effect was positive or negative and whether it was statistically significant or statistically insignificant. Some studies extended the empirical model to include the impulse response function and variance decomposition test. However, in such instances, studies in this regard were minimal as the test was used to identify which of the macroeconomic variables most influenced the stock market returns.

Given the commonly used stock market indices, macroeconomic variables, empirical model and identified relationship, there existed some answered considerations, namely could the relationship between stock market returns and macroeconomy be nonlinear in nature? If so, was the identified relationship consistent among linear and nonlinear literature? To understand this effect and determine if there was room for the current study, the nonlinear literature was examined next to illustrate how the study adds to the linear and nonlinear gap in the literature.

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2.3.2. Nonlinear Relationship

2.3.2.1. The Relationship between Macroeconomic Variables and International Markets:

In an earlier study, Longin and Solnik (2001), examined the nonlinear effect between macroeconomic variables and stock market returns. They found correlation was unrelated to market volatility but to market patterns and correlation increases in bear conditions as opposed to bull conditions. Finding an increase in correlation under a nonlinear effect was consistent with Bredin and Hyde (2005), using the smooth transition model (STM) they examined the nonlinear effect between macroeconomic variables and stock market returns of Canada, Japan, France, the United Kingdom (UK), Germany and the US. They found stock market returns to react in a nonlinear way to macroeconomic variables. The covariance associated with the market portfolio was seen to increase in the ‘crisis period’, where inflation (CPI) and interest rates were strong determinants of market returns. However, industrial production, REER and dividend yield had been identified in an individual case.

In a much more recent study conducted by Napolitano (2009), the asymmetrical relationship between macroeconomic factors and stock market returns of Economic Monetary Union (EMU) and industrialised countries were examined. Using the two-state Markov regime-switching model, they found a significant nonlinear relationship between macroeconomic policy innovations and the EMU stock market returns. Furthermore, monetary policy innovations had a more significant asymmetrical effect on industrialised countries' stock market returns as opposed to EMU countries. It was seen that the effect was higher during a bear stock market as opposed to a bull stock market. Finding an asymmetrical relationship between stock market returns and macroeconomy contradicted a study by Kizys and Pierdzioch (2009), which found macroeconomic factors to affect stock market returns linearly.

Iqbal and Nawaz (2009) examined the nonlinear effect of inflation (CPI) rate on economic growth and investments by creating threshold levels for inflation (CPI) in Pakistan. They found a nonlinear relationship between inflation (CPI) and economic growth and inflation (CPI) and investments at all three threshold levels, namely low inflation, moderate inflation and high inflation. The findings showed that low inflation helped reduce financial market uncertainties in financial markets, which boosted investments in the country. Arouri, Lahiani and Bellalah (2010) also examined the asymmetric relationship between macroeconomic factors and stock returns of oil-exporting countries. Using the nonlinear multifactor model, they found stock market returns of United Arab Emirates, Qatar, Osman and Saudi Arabia to be nonlinearly affected by oil price fluctuations.

Beber and Brandt (2010) investigated the nonlinear relationship; however, good and bad news associated with macroeconomic announcements was examined to determine the effect it had on bond market returns during expansion and recession periods. Using the state-dependent jump model, they found stock market returns to be asymmetrically affected by US inflation (CPI), US producer price index, US civilian unemployment rates and US non-farm payrolls. The relationship was more significant when it contained bad news of the bond market in expansions as opposed to good news during recessions. In a contrasting study, Arouri and Jawadi (2010) used the nonlinear error correction models (NECM) to determine if there existed a short-run and long-run nonlinear cointegration between the stock markets. The findings showed that stock markets were nonlinearly cointegrated with the world market. However, Mexico exhibited a higher level of cointegration. It was further seen that stock market integration was asymmetrical and time-varying.

Mishra and Singh's (2012) aim was to determine if there existed a nonlinear relationship between macroeconomic variables and Indian stock market returns using the non-parametric and a semi-parametric model. The findings showed that inflation (CPI), industrial production, interest rate and exchange rate demonstrated a nonlinear relationship with the Sensex and S&P CNX Nifty Index returns. Moreover, it was seen that the semi-parametric model was better suited to the estimate the desired relationship. Consistent with this, Constantinos and

Emmanouil (2012) used the asymmetrical ARDL model and found a positive and significant nonlinear relationship between inflation (CPI) and the S&P Index returns. Finding a positive asymmetrical link between economic growth was consistent with a study by Mili, Sahut and Teulon (2012), which found real GDP to have a positive asymmetrical influence on stock market returns.

Cakan (2013) examined the relationship between inflation uncertainty and stock market returns of the UK and the US by using non-parametric models. They found a nonlinear bi-directional causality between inflation (CPI) and the S&P 500 Index returns and FTSE 100 Index returns. The findings showed that stock markets were used to eradicated inflation uncertainty. Hsing (2013a) also investigated the nonlinear effect of macroeconomic variables on the Japanese stock market returns. Using the E-GARCH mode, they found a negative nonlinear relationship between stock market returns and GDP, interest rate, inflation (CPI) and REER. In contrast, a positive nonlinear relationship was found for the exchange rate and industrial production. Finding a negative nonlinear with inflation (CPI) contradicted a study by Hsing (2013b), which found a positive nonlinear effect link with Slovakian stock market returns.

Mensi. Hammoudeh, Nguyen and Sarafrazi (2014), used the linear heteroscedasticity robust model and the nonlinear causality procedures to determine the relationship between the Islamic and global financial markets as well as how it was affected by macroeconomic shocks. The findings showed that a nonlinear relationship existed between European and Asian stock market returns and US federal funds rate, US policy uncertainty and interest rate. Fatnassi, Slim, Ftiti and Maatoug (2014) also aimed to determine if there existed a nonlinear relationship between macroeconomic variables and the real estate investment trust (REIT) in the UK. Using the Markov regime-switching model, they found inflation (CPI), short-term interest rate and money supply (M3) to have a nonlinear relationship with the REIT Index returns. The effect was seen to be higher in the bust market as opposed to a booming market. Also, using the Markov regime-switching vector autoregressive model (MS-VAR), Chkili and Nguyen (2014) find the exchange rate of each country to react nonlinearly under low volatility regime and high volatility regime.

Saman (2015) examined the nonlinear relationship between the exchange rate and the Romanian stock market using the threshold error-correction model. They found a long-term asymmetrical relationship existed between the BET Index returns and the exchange rate.

Moreover, a short-run nonlinear relationship was found to exist between the two variables in regime 1 that was the bad news regime. Consistent with this, Veli and Seref (2015) found that stock market returns of the emerging markets are asymmetrically influenced by exchange rate fluctuations. Lin and Wo-Chiang (2015) also investigated the effect of macroeconomy on stock market returns. However, they use the REIT returns and in regime 1 (high) and regime 2 (low), there was a significant positive nonlinear relationship between the REIT Index and interest rates.

In a master's thesis by Panmanotham (2016), the nonlinear relationship between macroeconomic variables and Thailand stock market returns was examined. The STAR model found interest rates and the unemployment rates to have a nonlinear relationship with stock market returns. Also, finding a nonlinear link with macroeconomic variables, Effiong (2016) used the nonlinear granger causality test and found a bi-directional dependency existed between the Thailand stock market index and the exchange rate. However, a single direction dependency existed during each regime, namely, boom, bust and recovery conditions. Moreover, the relationship that existed was nonlinear and persistent in the capital market of Thailand. Finding a nonlinear relationship was consistent with a study by Abadi and Ismail (2016), which used the logistic smooth transition regression model and found a nonlinear relationship in the Japanese stock market. Furthermore, it was seen that during bull market periods, stock market returns were likely to stay longer as opposed to bear markets.

In a more recent study, Cheah, Yiew and Ng (2017) examined the asymmetrical behaviour of the exchange rate and stock market returns in Malaysia. Using the nonlinear autoregressive distribution lag (NARDL) mode, they find a short-run and long-run nonlinear relationship between the Malaysia stock market and NEEX under each regime. Borjigin, Yang, Yang and Sun (2018) also investigated the nonlinear effect of the macroeconomy on the Chinese Stock Market returns using the nonlinear granger causality test. They found a nonlinear relationship between the Shenzhen Component Index and GDP, inflation (CPI), import and export trade, the balance of trade, money supply (M1 and M2) and fixed asset investment. Consistent with this Chang and Rajput (2018) and Yacouba and Altintas (2019) also found a nonlinear link with the variables.

2.3.2.2. The Relationship between Macroeconomic Variables and Local Markets:

In an earlier study conducted by Moolman (2004), the aim of the academic was to develop a model to examine the relationship between macroeconomic variables and the SA stock market. They used the threshold cointegration test of Enders and Siklos (2001) and a Markov switching-regime model and found asymmetry market shocks were not a direct result of over or undervaluation or the direction of the error terms. Moreover, exchange rates and interest rates are the leading cause of short-run fluctuations in stock market returns. In a similar study by Maghyereh (2006), using the MS-VAR model, they found a negative nonlinear relationship between the inflation (CPI) and the JSE All-Share Index returns. Furthermore, it was seen that there existed a nonlinear adjustment to long-run equilibrium.

Bonga-Bonga and Makakabule (2010) used the STM to investigate the connection between macroeconomic factors and the aggregated JSE returns. The findings indicated that fluctuations in dividend yield were an essential determinant of the nonlinear relationship in the SA capital market. Moreover, it was found that the nonlinear models outperform linear models. The finding of the paper was seen to violate the weak and semi-strong form tests of EMH. Consistent with this, Mariappan, Hari and Jyotishi (2013) used the NARDL model to investigate the relationship between the macroeconomy and developed, developing and under developing countries stock markets. They found an inverse (nonlinear) relationship between the SA stock market returns and exchange rates, unemployment rate and bank rates. Finding a nonlinear link with stock market returns and exchange rate was consistent with a study conducted by Courage, Andrew and Kin (2013), as a negative nonlinear relationship between exchange rate and returns was found.

Balcilar, Gupta and Kyei (2015) investigated the predictability power of Economic Policy Uncertainty (EPU) and the JSE All-Share Index returns. Using a non-parametric-parametric model, they found EPU to significantly predict the SA stock market returns. This demonstrated that the SA stock market was not efficient as investors can use EPU in the country to determine the stock market returns. It, therefore, refuted EMH in favour of AMH. Ali, Idris and Kofarmata (2015) also aimed to determine the nonlinear relationship between stock market returns and exchange rates using the asymmetrical cointegration procedure. They found the JSE All-Share Index returns to have a long-run relationship with the exchange rate. In addition, the SA stock market returns were affected by the exchange rate and the speed of adjustment is nonlinear.

Cifter (2015) used the Markov switching dynamic regression (MS-DR) model that contained two regimes, namely a recession and expansion period, to determine if stock market returns were affected by inflation (CPI). The concluding remarks were such the SA stock market returns were affected negatively during the recession regime as opposed to the expansion regime. This implied that stock market movements were regime-dependent and nonlinear. Consistent with this, Marx and Stuweg (2015) used the multiple regression/correlation model to find that a nonlinear negative relationship existed between the JSE All-Share Index and stagflation. The findings showed that the identified relationship remained constant across business cycle periods and not change. Finding a negative link with inflation (CPI) was consistent with a study conducted by Phiri (2017), which found a negative nonlinear relationship and a unidirectional causality between the JSE returns and inflation (CPI). This suggested that market participants did not use equity returns to hedge against rising inflation. Hence, investing in stock market returns was not a good hedge against inflation.

Tapa, Tom, Lekoma, Ebersohn and Phiri (2016) also investigated the linear and nonlinear effect of macroeconomy on stock market returns. However, they used the Engle-Granger test, threshold autoregressive test and the momentum threshold autoregressive test of cointegration. They found a positive nonlinear relationship between the JSE All-Share Index returns and the unemployment rate in the long run. The findings implied that by investing in stock market returns in SA did not expose investors to losses due to flatulating macroeconomic variables. Consistent with this, Fourie, Pretorious, Harvey, Van Niekerk and Phiri (2016) used the STR model to find a nonlinear correlation between exchange rate growth and the JSE All-Share Index returns. Furthermore, the relationship was positive and significant at a regime of less than six percent as opposed to the regime exceeding six percent.

Similarly, Cifter (2017) examined the effect of inflation (CPI) on the SA stock market. However, the MS-VAR model was used. The findings show that inflation (CPI) affects the JSE All-Share Index returns negatively in the short run. Furthermore, it was found that movements in stock market returns were regime dependent. These findings were consistent with studies by Marx and Stuweg (2015) and Phiri (2016). Nhlapho and Muzindutsi’s (2019) study was seen to deviate from the general performed studies evident in the literature, as the study considered the effect of political, financial and economic risk on the JSE All-Share Index returns and the All Bond Index returns. Using the NARDL model, they found an asymmetric relationship between country risk and the index returns. Moreover, political risk was seen to have a short-run and long-run effect on bond returns, whereas economic risk only had a short-run relationship.

2.3.2.2. Conclusion on Nonlinear Relationship

It was noted from the review of the nonlinear literature that there existed minimal studies that had undertaken to investigate the asymmetrical relationship between stock market returns and macroeconomy. The international nonlinear relationship was extensively researched as opposed to SA studies, as international researchers understood the nonlinear impact macroeconomic fundamentals had on investors' portfolios. Concerning the review of the linear empirical studies, similar stock market returns and macroeconomic factors had been evident under the nonlinear empirical literature (Panmanotham, 2016; Kofarmata, 2015; Cifter, 2017), namely aggregated stock market returns, money supply (M2), industrial production, REER, GDP, exchange rate in terms of the domestic currency as of the US dollar and the inflation proxied by CPI.

The relationship between stock market returns and macroeconomic fundamentals was not standardised within emerging economies and there was no general consensus on whether or not the macroeconomy affected the stock market returns positively or negatively. As it was evident a positive (negative) relationship existed amongst the linear empirical literature for GDP, REER and industrial production (inflation), it was then found to be negative (positive) under the nonlinear empirical research (Hissing, 2013a; Constantinos and Emmanouil (2012). This suggested that the type of impact macroeconomic fundamentals was said to have on stock market returns under the linear literature was not the same for nonlinear research. Given the conflicting findings and the limited nonlinear empirical studies considered by academics, the debate surrounding the correctness of the type of relationship that existed still prevailed. It was, therefore, essential that more research in this regard (nonlinear relationship) was administered to reach conclusive findings.

In addition to the above mentioned, the review of the literature had, however, left a few questions without specific answers. It was noted among the SA literature that academics had not attempted to examine the nonlinear relationship between stock market returns and macroeconomic factors under bull and bear market conditions. It was, therefore, unknown how macroeconomic fundamentals were said to impact the SA aggregated and disaggregated stock market returns in upper and lower market conditions, as well as how long the SA stock market was said to remain in these market conditions.

Given a similar study was considered among international literature, it served as a justification for the study to be administered in SA. Most importantly, given that there existed no review of this kind in SA, the study was unique, as it is the first study that considered in the SA context.

2.4. Chapter Summary

That chapter commenced with a detailed discussion surrounding financial theories namely, EMH, behavioural finance, CAPM, APT and the AMH. According to EMH, macroeconomic factors did influence stock market returns, were such an affect was nonlinear. The basis of EMH was such that market participants are rational and stock prices reflect all available information, which limited the enhancement of access returns. However, behavioural finance was introduced to demonstrate that investors did not always act rationally due to ad hoc characteristics presented by the theory. Thereafter, CAPM and APT was presented to demonstrate how macroeconomy theoretically effected stock prices. These theories considered macroeconomy as a risk factor in the models, which was unobservable in nature, therefore, undiversifiable by investors. The AMH theory was then presented and was found to be the basis of the study. The theory contested EMH by showing that the affect between macroeconomy and stock market returns is nonlinear, as changing market conditions result in alternating efficiency of stock market returns. The subsection was then concluded and the empirical review of literature was then conducted. The subsection reviewed international and local linear relationship between macroeconomic factors and stock market returns. Thereafter, the nonlinear relationship between macroeconomy and stock markets returns was reviewed and concluding remarks were presented.

The next chapter contains the research methodology, data and sampling period used in the study. Moreover, it provides a detailed discussion surrounding the empirical statistical model, the Markov regime-switching model and its mathematical representation.

CHAPTER 3: DATA AND METHODOLOGY

3.1. Introduction

The study's objective entailed analysing the effect of macroeconomic variables on the JSE selected sector returns in the presence of different (bull and bear) market conditions. A nonlinear regime switching model was required to examine the objective, as bull and bear market conditions occurred at different time intervals (Chen, Zhou and Dai, 2015). Hence, the empirical model needed to cater for switching effects, in other words, from a bull market regime to a bear market regime. Thus, the objective of this chapter entails providing a justification surrounding the selection of the JSE sector returns, macroeconomic variable, sample period and empirical statistical model. This chapter commences with the research application and strategy that outlines the desired approach of the proposed study. Thereafter, the description of the sample selection and data sources is outlined. Moreover, the macroeconomic fundamentals and its interaction with the SA stock market is eluded to. The empirical statistical mode, primary tests and diagnostic tests is then elaborated upon. Lastly, a chapter summary is presented.

3.2. Research Application and Strategy

To answer the proposed research objectives, financial and macroeconomic theories were taken as the presiding approach. The preliminary investigation entailed examining the relationship between macroeconomic variables and the JSE industry-based indices under bull and bear market regimes. This study employed a quantitative research strategy whereby the properties and attributes of the relationship between macroeconomic variables and JSE stock market returns, under changing market conditions, were administered through the obtainment of quantitative financial and economic data. A quantitative approach allowed for numerical data and empirical statistical models to analyse a relationship or affect (Young, 1981). The quantitative approach was suited for the study as the analysis required the use of numerical data (JSE returns and macroeconomic variables) and a statistical model (Markov regime-switching model) to analyse a specific effect (the effect of macroeconomy on stock market returns under changing market conditions). The approach was beneficial as it provided the ability to investigate large sample sizes and high-frequency data, which was essential when analysing nonlinear effects (Rahman, 2017). It was essential as bull and bear market conditions occurred at different periods and over a large time interval. Therefore, high-frequency data and extensive sample periods were needed to capture the switching mechanisms (McCulloch and Tsay, 2001).

3.3. Data Collection and Sampling

The study utilised a time series analysis for a period converging from 29 February 1996 to 31 December 2018. The sample period was selected to cater to the contagion effects of a democratic SA (post 1994), 1997 Asia financial crises, 2000 SA inflation target regime, 2002 currency crisis and the 2008/2009 global financial crises. These effects dictated how the stock market conditions behaved, therefore, affected the formation of bull and bear market conditions (Mpofu, 2011). The study opted to use monthly data as high-frequency data points and long sample periods were needed to capture the switching mechanisms (i.e. bull and bear), to ensure correct identifications of market conditions (McCulloch and Tsay, 2001). The use of an extensive sample period and high-frequency data points allowed for a total of 275 data observations. These data points were deemed sufficient for the analysis as it captured the periods of bull and bear markets.

The secondary data for the SA stock market were obtained from the McGregor BFA database and comprised of monthly closing prices for the JSE All-Share Index, Industrial Metals and Mining Index, Consumer Goods 3000 Index, Consumer Services 5000 Index, Telecommunications 6000 Index, Financials 8000 Index and the Technologies 9000 Index. The SA macroeconomic factors were obtained in monthly figures from the SA Reserve Bank (SARB) and Statistics South Africa (Stats SA). The macroeconomic variable consisted of the inflation (CPI) rate, industrial production rate, short-term interest rate, long-term interest rate, Money Supply (M2) and REER. The industrial production rate could only be obtained in quarterly figures. It was therefore extracted and converted in the EViews statistical software to obtain monthly observations. The detailed discussion of each variable is discussed in the subsequent section.

3.4. JSE Industry and Macroeconomic Variables Description

In Section 3.4, a description of the JSE industry-based indices and macroeconomic variables is elaborated upon. In Section 3.4.1, the JSE sector classification and JSE industry-based index selection is communicated. Thereafter, Section 3.4.2 includes the macroeconomic variable description and, lastly, a summary of the JSE industry-based indices and macroeconomic variables is eluded to.

3.4.1. JSE Sector Classification

The study had opted to use one sector-based index and six industry-based indices, namely JSE All-Share Index, Industrial Metals and Mining Index, Consumer Goods 3000 Index, Consumer Services 5000 Index, Telecommunications 6000 Index, Financials 8000 Index and the Technologies 9000 Index. The various sector-based and industry-based indices were tradable and available to investors on the JSE. The use of sector-based and industry-based indices in the study was attributed to the limited studies that had considered industry-based indices and macroeconomic variables. It was noted from the reviewed empirical literature in Chapter 2 that there were limited studies that attempted to understand how macroeconomy affects industry-based indices. Moreover, using a combination of sector-based and industry-based indices resulted in an insightful granularity analysis (Naicker, 2017). The industry-based indices selection had been made per the highest market capitalisation rate of all industry-based indices listed under the resource sector, industrial sector and the financial sector. The use of high market capitalisation rates served as a benchmark for the capital market, which increased the reliability of the findings and provided an indication as to what effect macroeconomic factors had on the disaggregated indices as opposed to the overall market.

The JSE All-Share Index is an important aspect of the SA equity market, that being, it serves as a proxy for the SA capital market. It reflected how individual indices listed on the JSE were performing in relation to the overall market. It was essential that the study utilised the JSE All-Share Index as it allowed for the determination of whether macroeconomic variables had the same effect on each industry under changing market conditions, in addition to the aggregated stock market. The JSE All-Share Index is classified according to the Industry Classification Benchmark and demonstrated in Figure 3.1:

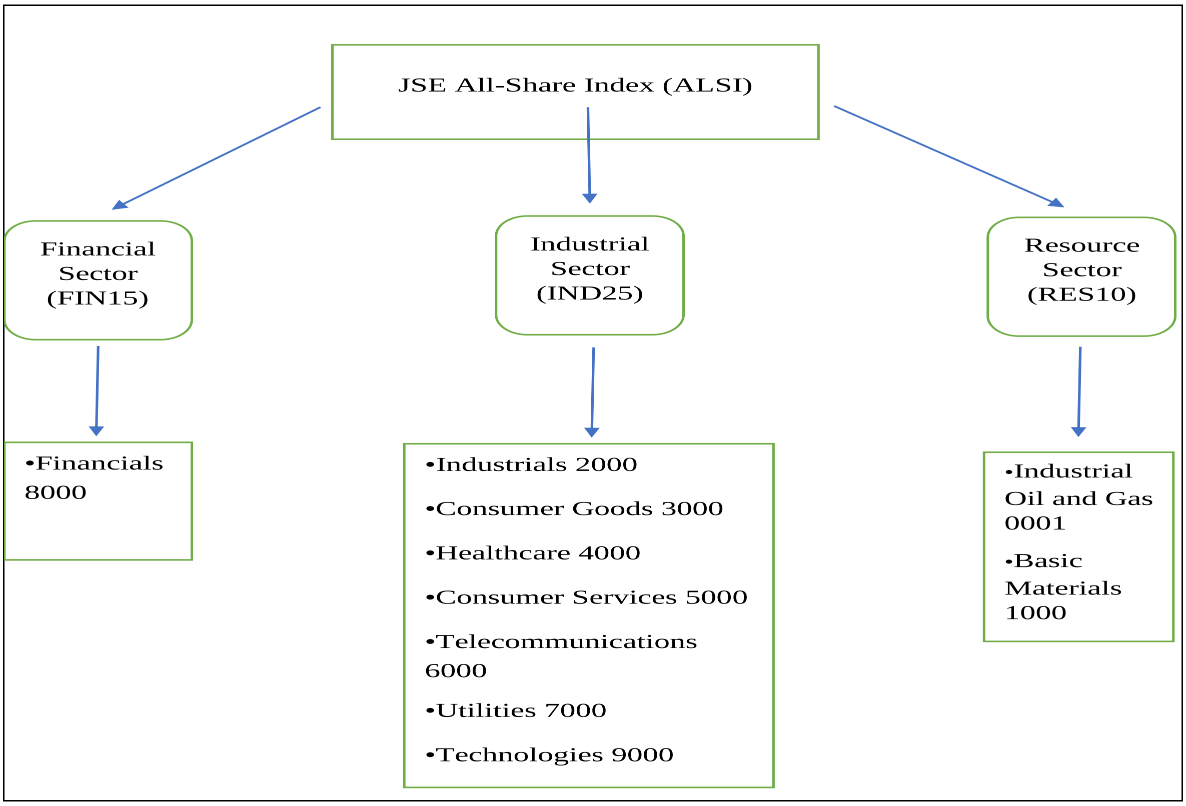

Figure 3.1: JSE ALSI Sector and Industry Synthesis
Data Source: (JSE, n.d.)

The JSE All-Share Index constitutes of 164 companies listed on the JSE and is the largest index concerning size and value, as it represents 99 percent market value of securities that form part of the JSE main board (SAShares, 2020). The JSE All-Share Index was segregated into three sectors, namely the JSE Financial 15 Index, JSE Industrial 25 Index and the JSE Resource 10 Index. The Financial 15 sector Index comprises of the 15 largest financial firms listed on the JSE and was used by the JSE to segment the top 15 financial companies that traded on the JSE (Satrix, 2020). The companies that form part of the index were ranked according to their market capitalisation rates and consisted of companies that formed part of the SA banks and insurance brokers. Furthermore, the Financial 15 sector Index was further segregated into an industry-based index known as the Financial 8000 Index.

The Industrial 25 sector Index was also ranked according to the market capitalisation rates. However, it consisted of the 25 largest industrial companies trading on the JSE (Satrix, 2019). These companies were further categorised into seven industry-based indices: Industrial 2000 Index, Consumer Goods 3000 Index, Healthcare 4000 Index, Consumer Service 5000 Index, Telecommunications 6000 Index, Utilities 7000 Index and Technologies 9000 Index. On the other hand, the Resource 10 Index comprised of the ten largest resource companies listed on JSE and ranked according to their market value (Forssman, 2017). The companies were further grouped into industry-based indices and consisted of the Industrial Oil and Gas 001 Index and Basic Materials 1000 Index. Of the three-sector indices, the Industrial 25 Index had the highest market capitalisation rate of R7,144,296,749,681, which was followed by the Resource 10 Index (R2,207,612,889,983) and Financial 15 Index (R2,019,761,265,829) (obtained from the McGregor BFA data based).

3.4.1.1. JSE Industry Selection

The Industrial Metal and Mining Index

The Industrial Metal and Mining Index is made up of a single company – Kumba Iron Ore Ltd (Infront Data Base). The index market capitalisation rate consisted of 1.14 percent of the JSE All-Share Index market capitalisation. This suggested that the company listed under the index was fairly large and market participants were willing to pay the fair value for the share. The SA Industrial and Metal and Mining sector contributed R351 billion to GDP in 2018 with a total of 456 438 people being employed in the sector (Minerals Council, 2020). The sector attracted foreign direct investments, which contributed tremendously to the SA economy. Thus, Industrial Metal and Mining sector was an important contributor to the economy. Hence, it was incorporated in the study.

The Consumable Goods Index and the Consumable Service Index

The Consumable Goods Index comprises of 12 companies (refer to appendix A) and the index contributed approximately 31.48 percent of the JSE All-Share Index market capitalisation rate. However, the Consumable Service Index consists of 26 companies that was listed on the JSE (refer to appendix A), the total company's market capitalisation rate accounted for 5.63 percent of the over market capitalisation of the JSE All-Share Index. These sectors contributed 61.04 percent to GDP between 2008 and 2018 (Statista, 2020). Thus, the Consumable Goods sector and Consumable Service sector contributes substantially to GDP and the economy of SA. Hence, the study considered these industries.

The Telecommunication Index

There are 4 companies that form part of the Telecommunication Index, namely MTN Group Ltd, Telkom SA SOC Ltd, Blue Label Telecommunication Ltd and Vodacom Group Ltd (obtained from Infront database).These companies had a total market capitalisation rate that constituted 3,62 percent of the total market capitalisation rate of the JSE All-Share Index. This suggested that the companies were fairly large and investor foresee future prospects in the company's share price. The SA telecommunication sector grew by 14 percent in 2018 and contributed R187 billion to GDP (Dublin, 2019). Thus, it is a significant contributor to the SA economy, therefore, incorporated in the study.

The Financials Index

The Financials Index has 61 companies listed under the index (refer to appendix A). The overall index accounted for 19.30 percent of the JSE All-Share Index market capitalisation rate. The SA Financial Sector was said to constitute around 22 percent of the GDP (Brand SA, 2019). This was substantial and illustrated how important companies under the Financials Index were to the economy of SA. Thus, it was important to understand how macroeconomic variables influenced the Financials Index returns under changing market conditions, as it had a direct effect on the economy of SA and not only the equity market.

The Technologies Index

There are 4 companies that form part of the Technologies Index, namely Allied Electronics Corp A, Datatec Ltd, Naspers Ltd -N and Prosus N.V. These companies had a market capitalisation rate that constituted 11.7 percent of the total market capitalisation rate of the JSE All-Share Index. The SA Technologies sector contributed 7.6 percent to GDP in 2018 (BusinessTech, 2019). This contribution was substantial and illustrated just how much the companies that formed part of the index contributed to the economy. Hence, the Technologies Index was incorporated in the study. A detailed depiction of the Industry-Based indices market capitalisation rate is given in Table 3.1.

Table 3.1: Market Capitalisations of JSE Selected Indices

Index Code	Abbreviation	JSE Index	Number of Companies	Market Capitalisation (Rands)	Percentage of JSE ALSI
J203	JSE_ALSI	All Share	164	13,782,327,713,413	100%
J175	INU_IND	Industrial Metals and Mining	1	157,782,250,616	1,14%
J530	CONG_IND	Consumer Goods 3000	12	4,338,901,451,928	31,48%
J550	CONS_IND	Consumer Services 5000	26	776,232,192,933	5,63%
J560	TELCOM_IND	Telecommunicati ons 6000	4	498,335,400,525	3,62%
J580	FIN_IND	Financials 8000	61	2,659,577,351,336	19,30%
J590	TECH_IND	Technologies 9000	4	1,539,661,231,830	11,17%

Data Source: McGregor BFA and Infront Database

3.4.1.2. Data Transformation of Stock Market Indices

The data for the JSE indices were in the form of nominal monthly closing prices. However, for the study, such data needed to be converted to real monthly closing prices and real monthly returns. The study used real values to examine the real effect associated with JSE indices, as it permitted the identification of the extent to which an increase in the closing price of the JSE indices was caused by inflation as opposed to the actual growth rate (Kumaranayake, 2000). This provided a more accurate observation of financial trends, which was essential when determining the objective of the study (Koop and Quinlivan, 2000).

The formula used to convert the nominal closing price index data to real closing price index data (Kokoski, 2010) was given by:

$$\mathrm{RM_p} = \left(\frac{\mathrm{NP_t}}{1+ INF_t}\right) \tag{1}$$

RM_p was the real monthly closing price index, NP_t was given to be the current month's nominal stock closing price index, INF_t was the current month's inflation rate (proxied by the percentage change in CPI) and t was given to be the time.

After that, the real percentage monthly closing prices were converted to real monthly returns in order to prevent the observation of data that contained a unit root, which alters the accuracy of the estimated output (Brooks, 2014):

$$R_t = 100 \times \ In \left(\frac{RP_t}{RP_{t-1}}\right) \qquad (2)$$

R_t was the stock market returns, RP_t was given to be the current month's real stock closing price while RP_{t-1} was the previous month's real stock closing price, *In* was the natural log and t was given to be the time.

Graphical Representation of the JSE Indices:

Figure 3.2 visualises the performance of the JSE All-Share Index returns and the six industry-based indices returns across the sample period. The graphical representation was administered to determine how the various indices' returns fluctuate across the sample period. The various graphical presentations contained bull and bear markers, such that the green line represented an increase in the JSE index returns (bull market condition) and the red line gave the decrease in the JSE index returns (bear market condition).

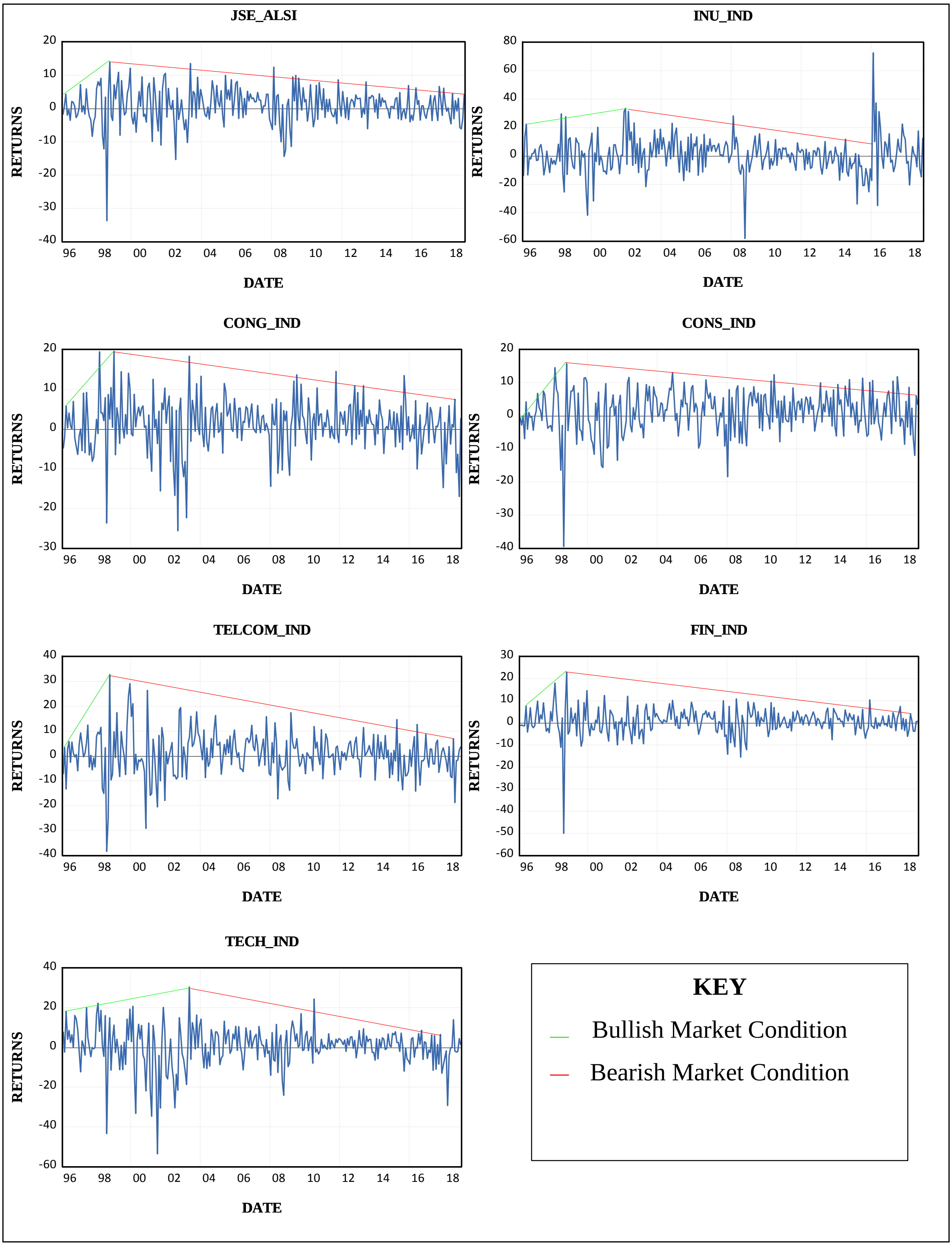

Figure 3.2: JSE ALSI and Industry-Based Indices
Data Source: Own compilation

The critical period that was immediately making a note of itself was the years 1998 and 2008, in which the contagion effect of the Russian economic crisis of 1998 and the 2008/2009 global financial crisis induced recessions periods across global stock markets (Mpofu, 2011). The 1997 spike in returns and the 1998 drop-in returns demonstrated how the recession manifested itself on the JSE stock market. As all indices attributed maximum returns in 1997 and minimum returns in either 1998 or 2008. Moreover, it was noted for the JSE All-Share Index returns, Consumable Goods Index returns, Telecommunication Index returns, Financials Index returns, Consumable Service Index returns and Technologies Index returns that an upward or bullish trend was experienced from 1996 to 1998 and after that, a bearish trend was observed from 1998 to 2018. However, for the Industrial Metal and Mining Index returns, an upper market condition was evident from 1996 to 2002. After that, a lower market condition existed from 2002 to 2015. The bullish and bearish market conditions are merely identified graphically and in such an instance, it could be incorrect. Therefore, the study confirmed the bullish and bearish periods by utilising the Markov regime-switching model of the conditional mean.

3.4.2. Macroeconomic Variables

The selection of the macroeconomic variables was based on the significant relationships identified under the empirical literature in Chapter 2. The use of the empirical literature as a guide for identifying relevant variables was essential as it served as an elimination factor for variables that had no purpose in the study, which improved the accuracy of the research findings. The macroeconomic variables consisted of the growth rate of the SA inflation rate, SA broad money supply rate (M2), SA short-term interest rate, SA long-term interest rate, SA industrial production rate and SA REER. A detailed discussion of each macroeconomic variable and its graphical trend for the period under investigation is discussed below.

3.4.2.1. Inflation (CPI) Growth Rate

The inflation rate is a key indicator that is frequently monitored by monetary authorities as it provides insight into the performance of an economy (Mohr, 2008). A rise in the inflation rate has negative affect on a country's economy, whereas a stable inflation rate suggests an efficient economy (Rangasamy, 2009). It was noted in the literature that CPI was the preferred measure used among academics when determining the effect inflation had on stock market prices (Majija, 2017; Ndlovu et al., 2018; Ncanywa and Ralarala, 2019). Thus, the change in CPI was used as the proxy for the SA inflation rate. The change in CPI is known as headline CPI as it is an inflation-targeting measure that guides how the SARB set interest rates (SARB, 2007). It is represented in a monthly percentage index by Statistics SA of which the growth rate was used in the study.

The empirical literature showed that fluctuating inflation rates caused stock market prices to deviate from its actual value. This resulted in inflation eroding private sector revenue and purchasing power of disposable income (Ray, 2012). Market participants reacted by extracting equity investments and invested in consumption, which decreased the demand for marketable instruments. Thus, it caused households and corporate entities to save extensively. Furthermore, the high inflation rates induced monetary policy authorities to increase interest rates to tighten the eroding effect of disposal income and private sector revenue. Moreover, the increased domestic interest rates caused an increase in the discount rate used to evaluate shares (Kuwornu, 2012). It was, therefore, hypothesised that inflation effected stock market returns negatively (Marx and Stuweg, 2015; Phiri, 2016; Cifter, 2017). The hypothesised linear effect for inflation was not consistent with the nonlinear effect, as Cifter (2015) found inflation to positively (negatively) affect stock market returns during an economic expansion (economic recession). Thus, the effect inflation had on stock market returns varied when market conditions (i.e., bear and bull) were imposed.

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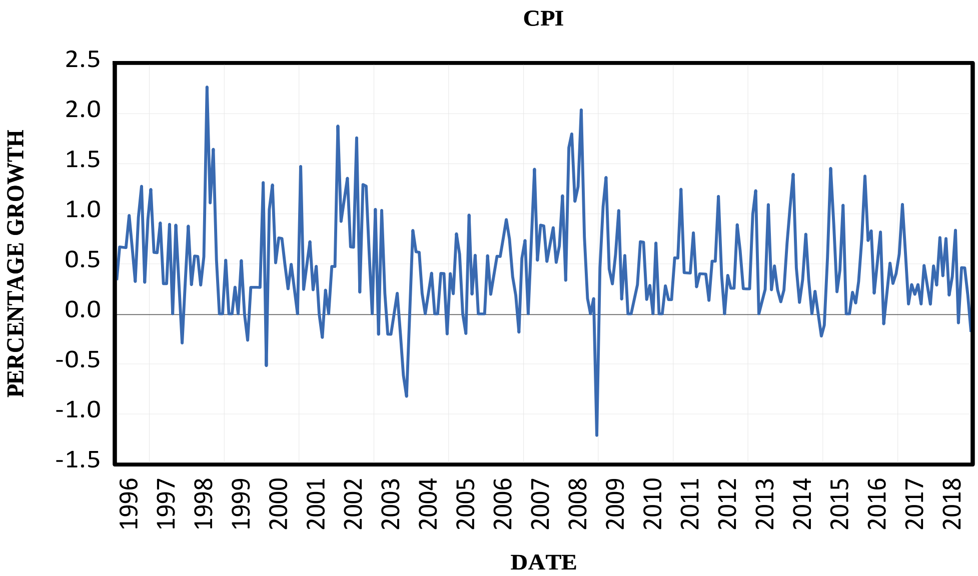


Figure 3.3: Inflation (CPI) Growth Rate
Data source: Own Compilation

Figure 3.3 demonstrates the inflation growth rate for the period 29 February 1996 to 31 December 2018. It was seen that inflation growth rate reached its highest level in 1998 and the lowest level in 2008. The figures were attributed to the implementation of an inflation targeting regime in 2000, which saw monetary authorities alter the inflation rate to cater for the inflation targeting policy (Mpofu, 2011). The growth in inflation was seen to increase from 1996 to 2008. After that, it decreased to 2018.

3.4.2.2. Money Supply (M2) Growth Rate

The money supply rate is an important economic indicator as it contributes to economic development and is used by monetary authorities to ensure price stability (Mukherjee, 2010). There exist different categorisations of money supply. However, the majority of empirical literate advocated for the use of the broad money supply (M2) rate as it is a more accurate measurement of price stability (Hsing, 2011; Tripathi and Kumar, 2016; Zakaria and Shamsuddin, 2012). The broad money supply rate is the measure of M1 (bank deposits and cash) plus M2 (market securities, saving deposits, mutual funds and other time deposits) (Orphanides, Reid and David, 1994). Hence, it is measured in millions of Rands by the SARB, of which the study utilised the growth rate.

The effect money supply had on stock market prices was said to be an empirical one. According to Fama (1981), an increase in the money supply caused the inflation rate and the discount rate to increase. When this occurred, investors incurred more significant opportunity costs, which caused a substitution effect away from marketable securities, which resulted in a decrease in stock prices and a decrease in the demand for marketable securities. However, money supply also tended to attribute positive outcomes relating to economic stimulus, whereby it increased stock prices and cashflows of corporates (Maysami and Koh, 2000). Thus, the overall effect of money supply on stock market prices was dependant on the extent to which it caused the discount rate and cash flows to vary from its actual value. Therefore, the money supply was hypothesised to have either a positive or negative effect on stock market returns. Maysami et al. (2005), Mohammad et al. (2017) and Molele (2019) found a positive association between money supply and stock market returns, whereas Hsing (2011) and Ndlovu et al. (2018) found a negative association. The effect under changing market conditions had varied with the market conditions (i.e., bull and bear) as the market's behaviour influenced how economic variables performed (Rassol, 2018).

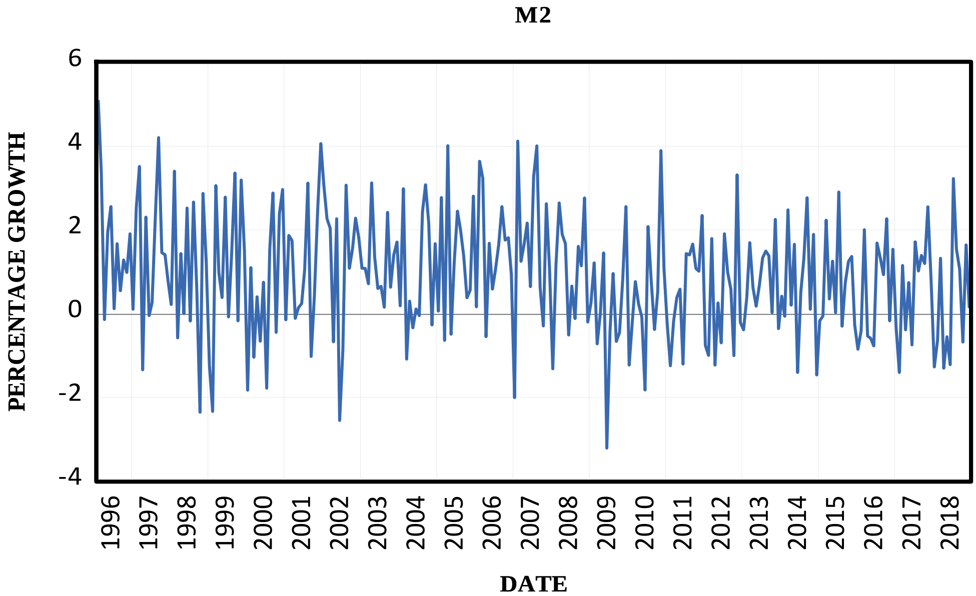


Figure 3.4: Money Supply (M2) Growth Rate
Data Source: Own Compilation

Figure 3.5 depicts the visual representation of money supply growth rate across the sample period. It was noted between 1996 and 2002 that the money supply growth rate decreased. However, from 2002 to 2006 the money supply growth rate increased and after 2006 it decreased until 2018. In the year 1996, money supply growth rate peaked at its highest growth level, whereas it reached an all-time low in 2009. The observed findings are due to monetary authorities' actions, as they attempted to alter the money supply rate to ensure price stability during the 1998 Asian financial crisis, 2000 inflation-targeting regime and the 2008/2009 global financial crisis (Mpofu, 2011).

3.4.2.3. Short-Term and Long-term Interest Growth Rates

Interest rates are important determinants of a countries economy. They influence the return on investments, the cost of borrowing and the total return on investments (Mehmet, Rangan and Kevin, 2016). Furthermore, interest rates provide an in-depth identification of economic and financial market activity (Redl, 2018). There existed different categorisations of interest rates. However, the empirical literature advocated for the use of 91-day Treasury Bill Rate as a proxy for short-term interest rate and the 10-year government bond yield as a proxy for the long-term interest rate (Adam and Tweneboah, 2008; Dube and Zhou, 2013; Naicker, 2017). This was done as the Treasury bill rates is short-term debt obligations by the government, whereas the government bond yields are long-term debt obligations of the government (Dube and Zhou, 2013).

The study selected the SA 91-day Treasury Bill Tender Rate (SA T-Bill) as a proxy for the SA short-term interest rate and the SA 10-year government bond yield as a proxy for SA long-term interest rates (Naicker, 2017; Dlamini, 2017). The short-term interest rate is expressed in weekly percentages by the SARB, whereas the long-term interest rate is given in monthly percentages. The study selected the percentages associated with the last week of each month as the monthly observations and converted them to growth rates. This was done to match the conversion frequency of other variables to ensure uniformity across data points.

Interest rates were considered to be an essential determinants of asset pricing. Thus, an increase (decrease) in short-term interest rates resulted in a higher (lower) discount rate. When the discount rate was said to increase, it prompted a higher opportunity cost for holding money, which resulted in market participants substituting equity-bearing securities for interest-bearing securities (Ray, 2012). This inevitably decreased the demand for equity securities. Furthermore, fluctuations in government bond yields were said to have the same effect on the discount rate. When the interest rate increased, it caused an increase in the nominal risk-free rate. As a result, the financial cost of corporates elevated (Mukherjee and Naka, 1995), thereby diminishing profitability and share prices. Given the above mentioned, it was hypothesised that a negative relationship existed between interest rates and stock market returns (Dhlamini,2017; Khan et al., 2018; Josiah, 2019). The effect under changing market conditions was said to vary (i.e. bull and bear) (Mensi et al., 2014).

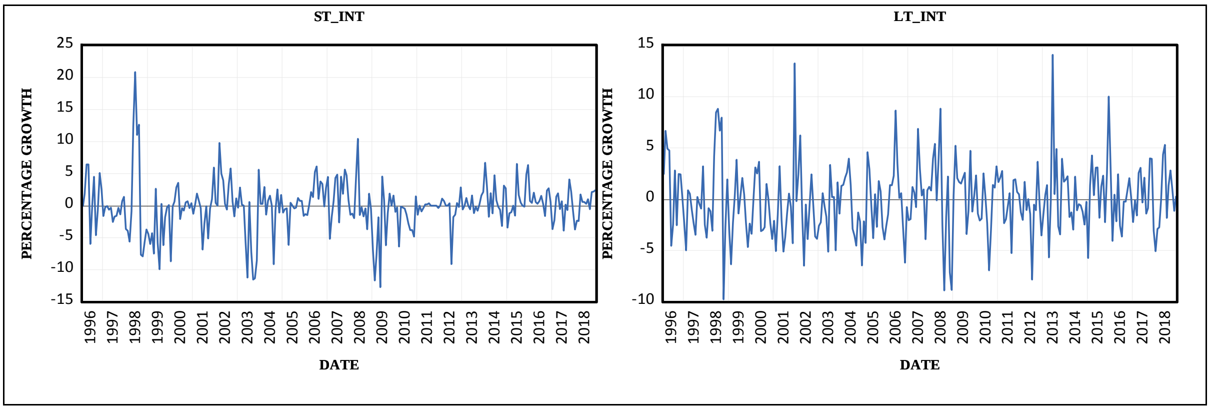


Figure 3.5**:** Short-Term and Long-Term Interest Growth Rates
Data Source: Own Compilation

It is seen in Figure 3.4 that the highest short-term interest growth rate was evident in 1998 and the lowest short-term growth rate was evident in 2009. However, the long-term interest growth rate reached its maximum level in 2013 as opposed to 1998 and its minimum level in 2008.

The low interest growth rates were a direct result of the 2008/2009 global financial crisis where the SARB lowered interest rates to stimulate economic activity (Dlamini, 2017). The short-term interest growth rate and long-term interest growth rate were stable over the sample period as it suggested that monetary policy implementation by the SARB was robust and efficient.

3.4.2.4. Industrial Production Growth Rate

The industrial production rate is a leading indicator of GDP and real economic activity due to its sensitivity to consumer demand and interest rates (Bradley and Jansen, 2004). Moreover, it is a measure of the industrial activity of any economy as it contains the Mining, Manufacturing and Utility sector, which are essential sectors for private companies listed on a stock exchange (Andreou, Gagliardini, Ghysels and Rubin, 2017). There existed various studies that advocated for the use of industrial production as a proxy for GDP (Bilson, Brailsford and Hooper, 2001; Gupta and Modise, 2013; Zaighum, 2014; Shawtari and Salem, 2015). Hence, the study utilised industrial production to illustrate the real economic activity of the SA economy. The industrial production rate was expressed in millions of Rands for each quarter of the year by the SARB. However, the study converted the quarterly figures to monthly figures by using the EViews statistical software to match the frequency of other variables. The quadratic average interpolation method was used to convert the data. The method was the most used to convert low frequency data to high frequency data as it took into consideration the most points in the data set. Dhlamini (2017) advocated for the use of such a method as it provided the most realistic characteristic of the original data values. Once the conversion was done, the monthly industrial production growth rate was found and used in the study.

The industrial production rate was said to attribute high sensitivities to the interest rates, whereby the lowering of interest rates by monetary authorities caused an increase in industrial production, which increases stock prices (Chen et al., 1986). Share prices were said to increase as the decreasing interest rate enticed investors to switch from interest-bearing securities to marketable securities to take advantage of the lower interest rates. This increased the demand for marketable securities, which inevitably increased stock market prices. Thus, industrial production was hypothesised to have a positive effect on stock market returns (Sohail and Hussain, 2009; Jareno and Negrut, 2016; Habib and Islam 2017). However, under changing market conditions (i.e. bull and bear), the effect was said to vary with the market condition (Tiryaki, Ceylan and Erdogan, 2019).

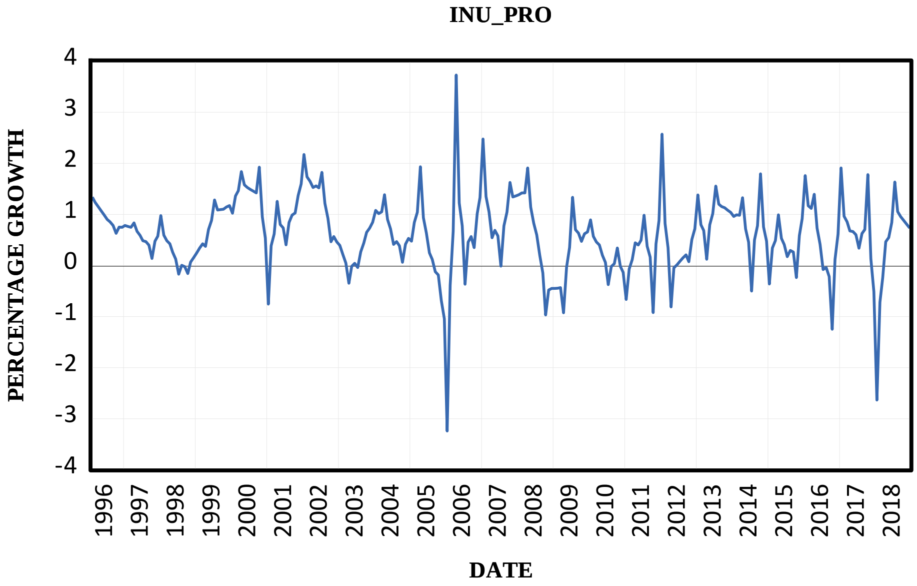


Figure 3.6**:** Industrial Production Growth Rate
Data Source: Own Compilation

The industrial production growth rate is illustrated in Figure 3.6. The industrial production growth rate peaked in the year 2006 and reached its minimum value in 2005. The upliftment of restrictions imposed by the apartheid government's industrial and trade policies saw an increase in trade liberalisation (Black, Craig and Dunne, 2017). This caused an increase in the export of goods, which increased the industrial production growth rate. Hence the increasing trend across the sample period.

3.4.2.5. Growth Rate of Real Effective Exchange Rate

The REER is an important economic indicator as it contains an essential relationship with net exports (Bahmani-Oskooee, 1995). If REER was high (low), it indicated the relative prices of goods in the domestic country was higher (lower) than that of international countries that formed part of the basket of currencies (Pettinger, 2017). Thus, REER is a measure of the development of the real value associated with a country’s currency divided by the basket of the trading partners’ currency and a price deflator, which synchronised the real values associated with the basket of currencies (Chinn and Menzie 2006). Therefore, the SA currency was divided by a basket containing the currencies of India, Germany, US, China, Japan and UK (Maynard, 2018). Hence, it is represented in a monthly percentages index by the SARB, of which the growth rate of the REER index was used in the study.

REER was a frequently used macroeconomic variable in both theoretical and empirical literature and monetary policy administration. It was used to access the trade flows by countries, the equilibrium value associated with each country's currency, price and cost competitiveness and the reallocation of incentives associated with both tradable and non-tradable sectors (Horobet and Ilie, 2007). Thus, REER was hypothesised to have a positive effect on stock market returns (Zhao, 2010, Sohail and Hussain, 2009). However, when changing market conditions were administered, the effect alternated with the market condition as Hsing (2013a) found a negative nonlinear relationship between REER and stock market returns.

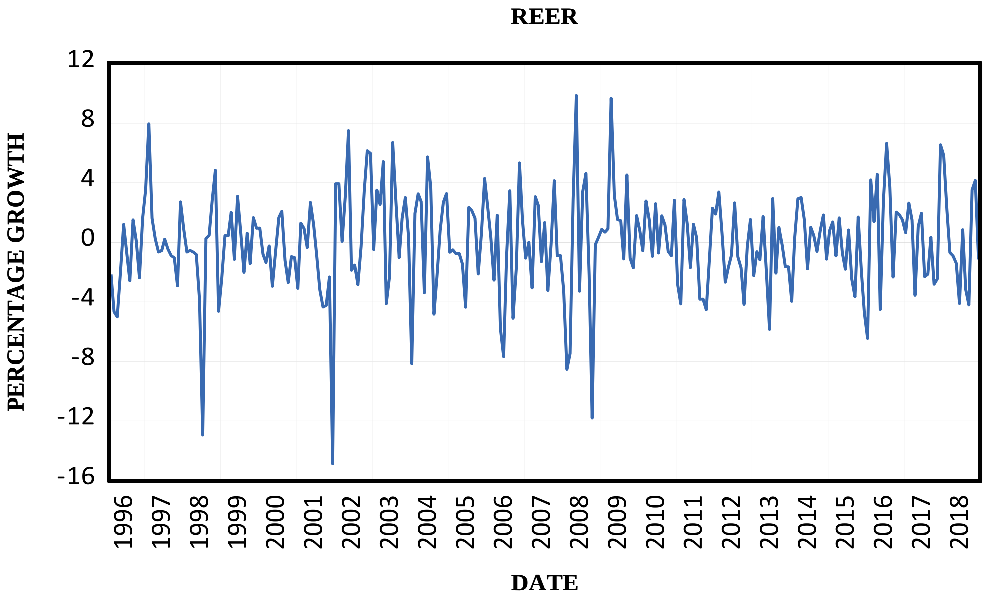


Figure 3.7: Real Effective Exchange Growth Rate
Data source: Own Compilation

The contagion effect of the Asia financial crises, global financial crises, low global commodity prices and speculative attacks on the SA currency saw a deprecation of growth rate of REER between 1996 and 2008 (Khomo, 2018). However. The appreciation of the SA nominal effective exchange rate and a decline in the SA inflation rate between 2002 and 2008 caused an appreciation of the REER (Khomo and Aziakpono, 2016). Thus, Figure 3.7 graphically depicts that the growth rate of REER experienced maximum spikes in 2008 and a minimum spike in 2002 with the growth rate of REER peaking and falling during such a time interval. Moreover, the growth rate of REER was decreasing over the sample period.

3.4.2.6. Data Transformation of Macroeconomic Factors

The data for the macroeconomic variables were obtained in the form of nominal monthly percentages. However, for the study, such data needed to be converted to real monthly percentages (except for REER and CPI as they were represented in real terms) and real percentage growth rate. The study used real values in order to examine the real effect associated with macroeconomic variables as it permitted the identification of the extent to which an increase in a macroeconomic variable was caused by inflation as opposed to the actual growth rate (Kumaranayake, 2000). This provided a more accurate observation of economic trends, which was essential when determining the objective of the study (Koop and Quinlivan, 2000). The formula used to convert the nominal percentage index data to real percentage index data (Kokoski, 2010) was given by:

$$RM_p = \left(\frac{\mathrm{NM_t}}{(1+(INF_t \div 100))}\right) \quad (3)$$

RM_p was the real monthly percentage, NM_t was given to be the current month's nominal macroeconomic percentage, INF_t was the current month inflation rate (proxied by the change in CPI) and t was given to be the time.

After that, the real percentage index data were converted to real percentage growth rate as the study was interested in how JSE index returns, which were represented as a percentage growth rate, were affected by changes in macroeconomic variables. Moreover, using the percentage growth rate prevented the observation of data that contained a unit root, which alters the accuracy of the estimated output (Brooks, 2014):

$$RG_r = \left(\frac{\mathrm{RM_t} - RM_{t-1}}{\mathrm{RM_{t-1}}}\right) \times 100 \quad (4)$$

RG_r was the real percentage growth rate, RM_t was given to be the current month's real macroeconomic percentage, while RM_{t-1} was the previous month's real macroeconomic percentage and t was given to be the time.

3.5. Summary of Dependent and Independent Variables

The summary of the dependent and independent variables in Section 3.4.1 and Section 3.4.2 was demonstrated in Table 3.2. The table contains the code associated with each JSE index and macroeconomic variable, the name of the variable, the type of variable (i.e., dependent or independent variable), the hypothesised effect macroeconomic variables have on stock market returns, the source of the obtainment of the dependent and independent data and the abbreviation used for each variable in the study.

Table 3.2: Summary of the JSE Selected Indices and Macroeconomic Variables

Code	**Variable Name**	**Type of Variable**	**Hypothesised Effect of Independent Variables**	**Source**	**Abbreviation**
J203	All-Share Index	Dependent	-	McGregor BFA	JSE_ALSI
J175	Industrial Metals and Mining Index	Dependent	-	McGregor BFA	INU_IND
J530	Consumer Goods 3000 Index	Dependent	-	McGregor BFA	CONG_IND
J550	Consumer Services 5000 Index	Dependent	-	McGregor BFA	CONS_IND
J560	Telecommunications 6000 Index	Dependent	-	McGregor BFA	TELCOM_IND
J580	Financials 8000 Index	Dependent	-	McGregor BFA	FIN_IND
J590	Technologies 9000 Index	Dependent	-	McGregor BFA	TECH_IND
STATS SA	SA Inflation	Independent	Negative	SARB	CPI
KBP1373M	SA Money Supply	Independent	Positive	SARB	M2
KBP1405W	SA Short-Term Interest rate	Independent	Negative	SARB	ST_INT
KBP2003M	SA Long-Term Interest Rate	Independent	Negative	SARB	LT_INT
KBP6634L	SA Industrial Production Rate	Independent	Positive	SARB	INU_PRO
KBP5392M	SA Real Effective Exchange Rate	Independent	Positive	SARB	REER

Data Source: Own Compilation

3.6. Model Description

In theory, the behaviour of market participants was said to dictate the type of relationship that stock prices take, which consisted of either symmetrical (linear) or asymmetrical (nonlinear) changes (Bonga-Bonga and Makakabule, 2010; Saeedi and Kuhsarian, 2010). When changing market conditions were administered in the form of bull and bear markets, the relationship was asymmetrical as these market conditions did not occur simultaneously but at different periods in a capital market (Ntantamis and Zhou, 2015). Hence, changing market conditions significantly influenced shares prices. In empirically regressing and examining the asymmetry, an indicator was considered that identified when the stock market was in an upper market condition (bull market) or lower market condition (bear market), the time period the stock market stayed in the respective market conditions and the degree of accuracy market participants regarded the stock market as either being in such a market condition. Therefore, to determine the relationship between macroeconomic fundamentals and stock returns under changing market conditions, a nonlinear model was needed to cater for regime switching. To account for the study's objective, such as nonlinearities or switches between the bear and bull, the study used the Markov regime-switching model.

The next section is structured as follows: Section 3.6.1 provides a detail identification of the empirical model with the benefits and limitations associated with the model. Thereafter, Section 3.6.2 contains a mathematical derivation of the model and lastly, the preliminary test and diagnostic tests associated with the empirical model are contained in Section 3.6.3.

3.6.1. Benefits and Limitations of the Markov Regime-Switching Model

The Markov regime-switching model was developed by Hamilton in 1989. The first application of the stochastic Markov regime-switching model was implemented in 1989 to model economic growth and the abrupt changes of a business cycle. Since then, it had been the preferred model among the empirical literature for determining bull and bear markets and the switching states of a business cycle (Maheu and McCurdy, 2000; Maheu, McCurdy and Song, 2012; Zare, Azali and Habibullah, 2013; Ahmad and Sehgal, 2015). An appealing factor of the model was that over a time interval the variable in question, which was the correct measure of the market conditions was considered to inherit a probability of switching across several regimes (Chu, Liu and Rathinasamy, 2004). In the case of the changing market conditions, bull and bear market conditions were considered as two regimes respectively. This meant that the market conditions switched between a high-growth and a low-growth regime, as portrayed by AMH. There existed different types of extensions of the Markov regime-switching model, which included the Markov regime-switching model of conditional mean, the duration-dependent Markov regime-switching model and the ARCH Markov regime-switching model (Cai, 1994; Kuan, 2002; De Paula, Mendes, Caldeira and Moura, 2018). Given the three types of models, the Markov regime-switching model of conditional mean with constant transition probabilities was used in the study.

The model contained multiple equations that ordered the time series behaviour into various regimes, which allowed for the observation of intricate dynamic patterns (Liu and Maheu, 2018). These dynamic patterns contained discrete shifts with their dynamics, therefore, was known as a Markov regime-switching process. A critical distinction between the Markov model and other models, such as the probit and logit models, was that the switching mechanism of the Markov regime-switching model was administered by an unobservable state factor, which followed a first-order Markov chain (Hamilton, 1989). That suggested that the current value of the state factor was dependent on its past value; hence, a pattern may be evident for a period, thereafter, it was replaced by another structure as switching took place (Hamilton, 2016). Moreover, the Markov regime-switching model did not require information on the dates of when the stock market was in each regime or the size of the growth rate of the market conditions; preferably, the probability of being in a bull or bear market condition was obtained from the data. The Markov regime-switching model comprised of structural changes as it permitted constant and non-constant changes at different time periods (Camacho, Perez-Quiros and Poncela, 2018). However, other nonlinear models (probit and logit) only considered exogenous changes at fixed time periods.

As with the benefits of using the Markov regime-switching model of conditional mean with constant transition probabilities, there also included limitations to the mode. The model assumed the data series contained stationary properties in the presence of structural breaks. (Hamilton, 1989). If the data series was non-stationary in the presence of structural breaks, then the model estimates was biased and inefficient. This was due to the transition properties of the model being constant throughout time, which did not cater for non-stationery properties with structural breaks (Paliouras, 2007). However, the limitation did not affect the study as structural break tests were estimated for the stationary series and when the study found the data series to be stationary with structural breaks, the Markov regime-switching model of conditional mean with constant transition probabilities was estimated.

3.6.2. Empirical Model Specification

In order to determine how macroeconomic factors influenced stock index returns under changing market conditions, it was essential to subject the stock index returns to a regime-switching model that catered for switching parameters, where the SA stock market index returns (I_t) was assumed to follow a process that was determined by an unobservable state variable C_t. The occurrence of a regime was divided into *N* states in period *t* when $C_t = N$, where $N = 1,2,3\ldots., N$. The Markov regime-switching model of the conditional mean permitted each regime with an alternate regression model, therefore, such a model that contained a switching intercept, error variance and regressors were given by:

$$\mathrm{I}_t = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta \mathrm{LT\_I}NT + \alpha_{4ict}\Delta \mathrm{INU\_PRO} + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \qquad (5)$$

Where $\varepsilon_{c_{t,}}\,\mathrm{i.i.}d\ (0, \sigma^2_{c_{t,}})$, I_t referred to the SA stock index returns, μ_{ct} was the state-dependent intercept (mean), $\sigma^2_{c_{t,}}$ was the regime-dependent variance of the returns and $C_t = 1,2$: illustrated two regimes, namely bull (1) and bear (2) regime, where the macroeconomic variables contained state-dependent coefficients. ΔCPI was the change in SA inflation rate, $\Delta M2$ was the change in the SA money supply rate, ΔST_INT was the change in SA short-term interest rate, $\Delta \mathrm{LT\_I}NT$ was the change in SA long-term interest rate, $\Delta \mathrm{INU\_PRO}$ was the change in industrial production and, $\Delta REER$ was the change in the SA REER. The hypotheses of the study were formulated as:

H1: Macroeconomic variables had a significant effect on the JSE industry stock returns in a bull market condition

H2: Macroeconomic variables had a significant effect on the JSE industry stock returns in a bear market condition

H3: The bull market condition remained the longest in the JSE industry-based indices

To examine if the effect was statistically significant under each market condition, the p-values associated with the macroeconomic variables' coefficients were examined at a 1 percent, 5 percent and 10 percent significance level. If the p-value fell within the statistical significance levels, the null hypothesis (the macroeconomic factor had an insignificant effect on the stock market index returns) was rejected in favour of the alternative hypothesis (the macroeconomic factor had a significant effect on the stock market index returns). Hence, Equation 5 was estimated seven times to cater for each stock market index. The seven estimated models were as follows:

$$JSE\_ALSI = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta \mathrm{LT\_I}NT + \alpha_{4ict}\Delta \mathrm{INU\_PRO} + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \tag{6}$$

$$INU\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta \mathrm{LT\_I}NT + \alpha_{4ict}\Delta \mathrm{INU\_PRO} + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \tag{7}$$

$$CONG\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta \mathrm{LT\_I}NT + \alpha_{4ict}\Delta \mathrm{INU\_PRO} + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \tag{8}$$

$$CONS\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta \mathrm{LT\_I}NT + \alpha_{4ict}\Delta \mathrm{INU\_PRO} + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \tag{9}$$

$$TELCOM\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta \mathrm{LT\_I}NT + \alpha_{4ict}\Delta \mathrm{INU\_PRO} + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \tag{10}$$

$$FIN\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta \mathrm{LT\_I}NT + \alpha_{4ict}\Delta \mathrm{INU\_PRO} + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \tag{11}$$

$$TECH\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta \mathrm{LT\_I}NT + \alpha_{4ict}\Delta \mathrm{INU\_PRO} + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \tag{12}$$

Each regime was given to follow a first-order Markov process demonstrated by the transition probability matrix. Under the first-order Markov process, the possibility of being in a specific regime was dependent on the most recent state, which was demonstrated as follows

$$Prob(\,C_t = j \mid C_{t-1} = i\,) = Prob_{ij}(t) \tag{13}$$

Where ij was the probability of switching from a regime denoted as i in a period denoted $t-1$ to a regime j in a specific period (t) where the probability was given to be constant for all periods so that $Prob(t)$= $Prob_{ij}$. Hence, the matric for a two-regime model was given by:

$Prob\ [C_t = 1 |\ C_{t-1} = 1] = Prob_{\ 11}$ (14)

$Prob\ [C_t = 2 |\ C_{t-1} = 1] = 1 - Prob_{\ 11}$ (14.1)

$Prob\ [C_t = 2 |\ C_{t-1} = 2] = Prob_{\ 22}$ (14.2)

$Prob\ [C_t = 1 |\ C_{t-1} = 2] = 1 - Prob_{\ 22}$ (14.3)

The above equations were simplified into a single equation:

$$Prob = \begin{bmatrix} Prob(C_t = 1/C_{t-1} = 1) & Prob(C_t = 2/C_{t-1} = 1) \\ Prob(C_t = 2/C_{t-1} = 2) & Prob(C_t = 1/C_{t-1} = 2) \end{bmatrix} = \begin{bmatrix} Prob_{11} & Prob_{21} \\ Prob_{22} & Prob_{12} \end{bmatrix} \quad (15)$$

Where $Prob_{11}$ was the probability that the stock index returns was at state one (bullish state) at $t-1$ and remained there at time t, $Prob_{21}$ was the probability that the returns was at state one (bullish state) at $t-1$ and moved to state two (bearish state) at time t. $Prob_{22}$ was the probability that the returns was at state two (bearish state) at time $t-1$ and remained there at time t, $Prob_{12}$ was the probability that the returns was at state two (bearish state) at $t-1$ and moved to state one (bullish state) at time t (Brooks, 2019). The probability of staying in each regime was generated and compared across the different JSE sectors. A logit model was followed when the probability of changing from regime i to j. Hence, the transition matrix rows above contained a full set of conditional probabilities. A new logit model was determined for each row of the transition matric:

$$Prob_n(G_{t-1}, d_i) = \frac{\exp(G'_{t-1}, d_{ij})}{\sum_{s=1}^{N} \exp(G'_{t-1}, d_{is})} \quad (16)$$

Where j = 1, …, N and i = 1, …, N with the normalisations d_{iN} = 0. Markov regime-switching models were normally and generally specified with constant probabilities so that G_{t-1} contained only a constant. The GDP model used in Hamilton's (1989) study was a clear example of a constant transition probability specification and was adopted for the study. Therefore, Equations 6 to12 were estimated to determine the effect macroeconomic variables have on each stock index returns under changing market conditions. The estimates from equation 15 identified bull and bear states and provided the total number of months each JSE index stayed in bull and bear regimes. The transition probabilities and the constant expected duration of each regime were compared across the JSE sectors to identify how each sector shifted between bull and bear regimes.

3.6.3. Preliminary and Diagnostic Tests

Markov regime-switching model of conditional mean with constant transition probabilities required data to have stationarity properties if structural breaks occurred in the stationary series (Paliouras, 2007). Hence, it was essential that these tests be administered before the model was estimated, as it affected the accuracy of the estimated output. Thus, the study imposed preliminary tests in the form of correlation tests, unit root and stationarity tests with and without a structural break. Moreover, residual diagnostic tests in the form of the normality test were conducted for equations 6 to 12. The detailed discussion of these tests is contained herein.

3.6.3.1. Correlation Analysis

The study employed the correlation coefficient test to examine the direction and strength of the relationship between the JSE index returns and macroeconomic variables. The correlation coefficient demonstrated the extent to which the JSE index returns were linearly associated with each macroeconomic variable (Banda, 2018). If the correlation coefficient value was positive it suggested that there existed a positive association between JSE index returns and macroeconomic variables. If the correlation coefficient was negative, it indicates there existed a negative association between JSE index returns and macroeconomic variables. The mathematical representation of the correlation coefficient test (Banda, 2018) was given by:

$$C = \frac{(n \sum xy - (\sum X)\ (\sum y))}{\sqrt{n}\ (\sum X^2) - (\sum X)^2 \sqrt{n}\ (\sum y^2)(\sum y)^2} \tag{17}$$

Where C referred to the correlation coefficient, n was the number of observations, X and y were the JSE index returns and macroeconomic variables.

3.6.3.2. Unit Root and Stationary Test

The commencement of the data investigation entailed determining the stationarity of the JSE indices and macroeconomic variables under consideration. According to Brooks (2014), a stationary process contained a constant autocovariance, variance and mean for each lag of a series. The stationarity test was considered an essential determinant as it identified and prevented the formation of autocorrelation in the residuals of regression as well as spurious estimations (Granger and Newbold, 1974). The empirical literature stated that the stationary autocorrelation process geometrically falls to zero in an autoregressive model (Brooks, 2014). Furthermore, when shocks were administered to the process in a stationary process, the system caused the shocks to fade away over time. However, in a non-stationary process (contains a unit root), such shocks were persistent and did not gradually fade away over time (Brooks, 2014).

One of the Markov regime-switching model requirements was that the dependent and independent variable incorporated within the model was pre-tested for stationarity with and without structural breaks (Kuan, 2002). Only when the series was found to be stationary at level or I(0), then the Markov regime-switching model was estimated and output interpreted. A confirmatory examination technique was utilised, such that unit root and stationarity tests were considered. The stationarity test, which formed part of the study was the KPSS test, whereas the unit root tests were the PP test and the ADF test. The ADF and PP tests' accuracy were limited by the low power of these tests when a series was stationary, but with a root near the unit root circle (Brooks, 2014). Therefore, to eradicate such limitations, a confirmatory examination was administered such that it incorporated the KPSS test, as Kwiatkowski et al. (1992) advocated for the use of stationarity tests (KPSS) with unit root tests (ADF and PP).

In addition to conducting the standard unit root and stationarity tests, a test was administered to determine if the dependent and independent variables were stationary in structural breaks (Paliouras, 2007). According to Casini and Perron (2018), a structural break was characterised as abrupt changes in time-series data attributed to changes in the mean or other parameters of the series. If a process was non-stationary in the presence of structural breaks, it suggested that the series did not revert around an identical mean for the sample period (Vogelsang and Perron, 1989). Hence, it resulted in the formulation of biased estimates and spurious regression, which raises questions of the accuracy of the interpretation. The study employed the Enders and Lee (2012) Fourier Augmented-Dickey Fuller (ADF min-t) test to illustrate that the series was stationary with structural breaks in the data. The ADF min-t test contained two forms, namely an innovation outlier (I0) and the additive outlier (A0) (Narayan and Smyth, 2005). The former (latter) assumed that structural breaks occurred in stages (immediately) and the structural breaks follow (do not follow) the identical dynamic pattern of the innovations. For the study, the innovation outlier was used. The method was used as structural breaks in time series data occurred in stages as it followed the innovations of the previous period. Hence, the innovation outlier method was better suited to determine the stationary of time series data in the presence of structural breaks.

3.6.3.2.1 The Augmented-Dickey Fuller and Phillips and Perron Test

PP unit root test and the ADF unit root test were said to test the null hypothesis (No): Unit root series and the alternative hypothesis (N1): Stationary series. Therefore, the null hypothesis was rejected in favour of the alternative hypothesis when the test statistic was more negative than the critical values (1 percent, 5 percent and 10 percent level of significance) of the estimation output**.**

The mathematical representation of the PPs and the ADF unit root test (Brooks, 2014) was given by:

$$\Delta y_t = \Psi y_{t-1} + \mu + \lambda t + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \mu_i \quad (18)$$

Where Ψ was the unit root, μ was an intercept, λ was the time trend, which can be included or excluded from the regression if found to be necessary or unnecessary, p was the number of lags and $\mu_i$was the white noise disturbance term.

The PP test was similar to that of the ADF test, but the PP test used automated correlation statistical techniques, which tested the autocorrelation of the residuals. The ADF test and ADF min-t breakpoint test used information criteria when determining the optimal lag length (Brooks, 2014). This included Akaike (1974) Information Criterion (AIC), Schwarz's (1978) Bayesian information criterion (SBIC) and Hannan and Quinn (1979) information criterion (HQIC). These information criteria were expressed mathematically (Brooks, 2014) and were given by:

$$AIC = In(\hat{\theta}^2) + \frac{2k}{T} \quad (19)$$

$$SBIC = In(\hat{\theta}^2) + \frac{2k}{T} In\, T \quad (20)$$

$$HQIC = In(\hat{\theta}^2) + \frac{2k}{T} In(In(T)) \quad (21)$$

Where $\hat{\theta}^2$was the residuals, k = p + q + 1, was the total number of parameters estimated at T and T was the number of observations, AIC selects the larger lag order and was preferred in small samples, SBIC selected the smallest lag order and was preferred in a large sample and HQIC was in between AIC and SBIC (Brooks, 2014).

3.6.3.2.2 The Augmented-Dickey Fuller Structural Break Test

The ADF min-t structural break test examined the null hypothesis (No): Unit root series with an unknown number of level breaks and the alternative hypothesis (N1): Stationary process with an unknown number of level breaks. Therefore, the null hypothesis was rejected in favour of the alternative hypothesis when the test statistic was more negative than the critical values (1 percent, 5 percent and 10 percent level of significance) of the estimation output**.**

The mathematical representation of the ADF min-t structural break test (Enders and Lee, 2012) was given by:

$$\Delta y_t = \Psi y_{t-1} + \mu D_L + \lambda t + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \mu_i \quad (22)$$

Where Ψ was the unit root, μ was an intercept, D_L and β_i were the breakpoint parameters, λ was the time trend, which can be included or excluded from the regression if found to be necessary or unnecessary, p was the number of lags and μ_i was the white noise disturbance term.

3.6.3.2.3 Kwiatkowski, Phillips, Schmidt and Shin Test

The KPSS Stationarity test, were said to test the null hypothesis (N0): stationary series and the alternative hypothesis (N1): series with unit root. Therefore, the null hypothesis was rejected in favour of the alternative hypothesis when the test statistic was larger than the critical values (1 percent, 5 percent and 10 percent level of significance) of the estimation output**.**

The mathematical representation KPSS stationarity test (Kwiatkowski, Phillips, Schmidt and Shin,1992) was given by:

$$\Delta y_t = (T^{-2} \sum_{t=1}^{T} \widehat{\mathrm{S}}\mathrm{t}^2) / \lambda^2 \quad (23)$$

Where St = $\sum_{i=1}^{t} \widehat{\mathrm{U}\iota}, \widehat{\mathrm{Ut}}$ was the residuals of the regression of y_t on D_t, λ^2 was a constant estimate of the long-run variance of U_t using $\widehat{\mathrm{Ut}}$.

3.6.3.3. Nonlinearity Test

There existed studies that have examined the nonlinear dependency that existed between the dependent and independent variables before using a nonlinear model. The Broock, Scheinkman, Dechert and LeBaron (1996) test was used to examine such dependency. However, the study did not employ dependency tests to examine the linear or nonlinear dependency among the stock market returns series and macroeconomic series. This was done for two reasons, one being that the study examined two regimes (i.e. bull regime and bear regime). Hence, a linear model did not cater for regime switching, therefore, it was redundant to conduct the nonlinearity test. The second reason was that empirical studies had found nonlinear dependency between stock market returns and macroeconomic variables and based on such findings the study concluded the existence of nonlinear dependency between the two series. Studies by Bong-Bonga and Makakabule (2010), Panmanotham (2016), Abadi and Ismail (2016) and Yacouba and Altintas (2019) used nonlinear models to examining stock market returns and macroeconomic variables.

3.6.3.4. Autocorrelation Test

The Markov regime-switching model and various other regime switching models had over past decades demonstrated the existence of long memory in the covariance, parameters or simulations of the models (Allan, 1966 and Dufrenot, Guegan and Peguin-Feissolle, 2005). These models' autocorrelation functions decayed frequently over time, which suggested short memory and long memory characteristics (Gueganand and Stephanie, 2005*).* Thus, there existed the possibility of a slow and quick decaying autocorrelation function with significant spikes after the estimation of the model. Guegan and Stephanie (2005) demonstrate this phenomenon and further illustrated that the sample size, transition probabilities and the number of means parameters influenced the presence of autocorrelation in the Markov regime-switching model. In this study, it was found that when the transition probabilities changed between 0 and 1, there existed slow and fast decaying autocorrelation functions with a number of significant spikes, long memory behaviour and seasonality in the autocorrelation function

(Guegan and Stephanie, 2007). Thus, it was clear there existed the possibility of autocorrelation in the Markov regime-switching model and it was, therefore, redundant to test for autocorrelation, as the transition probabilities of the Markov regime-switching model influenced the presence of autocorrelation. Hence, the study proceeded by not testing for autocorrelation in the residuals of the Markov regime-switching model given by equations 6 to 12.

3.6.3.5. Normality Test

The Bera and Jarque (1981) (known as the Jarque-Bera) test was the most common test used by academics in testing departure from normality. The test was applied by the study to determine the nature of the distribution of the residuals of the estimated models given by equations 6 to 12. The Jarque-Bera test utilised the summation of the kurtosis statistic and skewness of the coefficients associated with a model (Banda, 2017). If the coefficient of the residuals contained a kurtosis of zero, the residuals was normally distributed. Thus, the Jarque-Bera test examined the null hypothesis: residuals were normally distributed and the alternative hypothesis: residuals were not normally distributed. The p-value was used to reject the null hypothesis at all significance levels. If the p-value was lower than a 1 percent, 5 percent or 10 percent level of significance, the study rejected the null hypothesis in favour of the alternative hypothesis at the specific level of significance. The mathematical representation of the Jarque-Bera test statistic (Brooks, 2014) was given by:

$$JB = \left[\left(\frac{S^2}{6 \div N}\right) + \left(\frac{(K-3)^2}{24 \div N}\right)\right] \quad (24)$$

Where JB referred to the Jarque-Bera test statistic, S was the number of observations/sample size and K was the kurtosis coefficient. The Jarque-Bera test statistic was said to follow a chi-squared distribution that contained two degrees of freedom.

3.7. Chapter Summary

It was noted that the study aimed to examine the effect of macroeconomic variables on the JSE selected sector returns in the presence of different (bull and bear) market conditions. In determining the objective of the study, a quantitative analysis was perused. Thus, the study utilised monthly data obtained from McGregor BFA database, SARB and Statistics South Africa (STATS SA) for a period that commenced on 29 February 1996 and concluded on 31

December 2018. The dependent variables of the study comprised of the monthly closing prices of the JSE All-Share Index, Industrial Metals and Mining Index, Consumer Goods 3000 Index, Consumer Services 5000 Index, Telecommunications 6000 Index, Financials 8000 Index and Technologies 9000 Index. The independent variables consisted of the monthly growth rate of the SA Inflation (CPI), SA Money Supply (M2), SA Short-Term Interest, SA Long-Term interest, SA Industrial Production and SA REER.

A nonlinear regime-switching model was required to examine the study's objective, as bull and bear market conditions occurred at different time intervals (Chen, Zhou and Dai, 2015). Hence, the empirical model needed to cater for switching effects, in other words, from a bull market regime to a bear market regime. Thus, the Markov regime-switching model of conditional mean with constant transition probabilities was used to cater for the switching market conditions. However, before the model was estimated, preliminary and diagnostic tests were administered in the form of correlation analyses, unit root tests with and without structural breaks, stationarity tests and residual normality tests. The next chapter provides the estimated outputs and interpretation of the empirical statistical model and econometric tests.

CHAPTER 4: DATA ANALYSIS AND DISCUSSION

4.1. Introduction

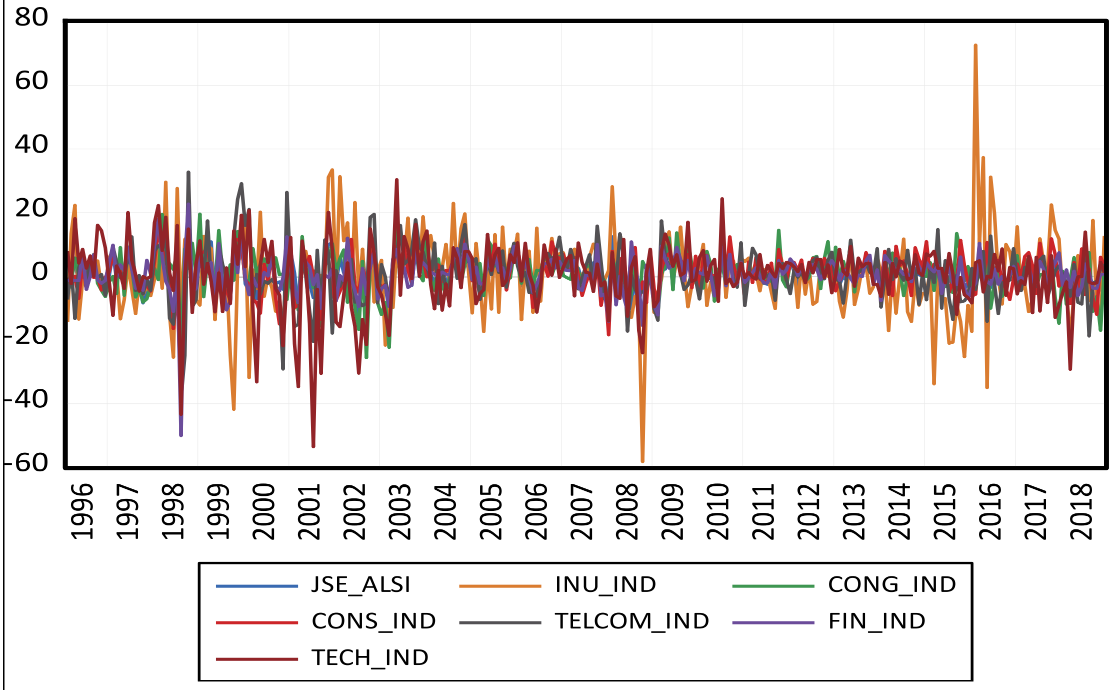
The empirical literature surrounding the effect macroeconomic variables had on SA stock market returns under changing market conditions was limited. However, there existed international studies that had considered the objective of the study. It was evident that the effect macroeconomic variables have on stock index returns were time-varying and regime-dependent (Bonga-Bonga and Makakabule, 2010). Thus, macroeconomic variables affected stock market returns differently under a bullish and bearish market condition (Maheu, McCurdy and Song, 2012). Hence, alternating efficiency and inefficiency were observable. Moreover, the empirical literature illustrated the phenomenon of stock market returns staying longer in an upper market condition as opposed to a lower market condition (Malik and Mumtaz, 2019). The chapter is structured as follows: Section 4.2 presents the preliminary tests. Thereafter, Sections 4.3 and 4.4 illustrates the Markov regime-switching model, whereas Section 4.5 depicts the Markov regime-switching model results, residuals diagnostic tests and interpretation. Lastly, the discussion of the results is conducted in Section 4.6 and in Section 4.7, a summary of the chapter is communicated.

4.2. Preliminary Tests

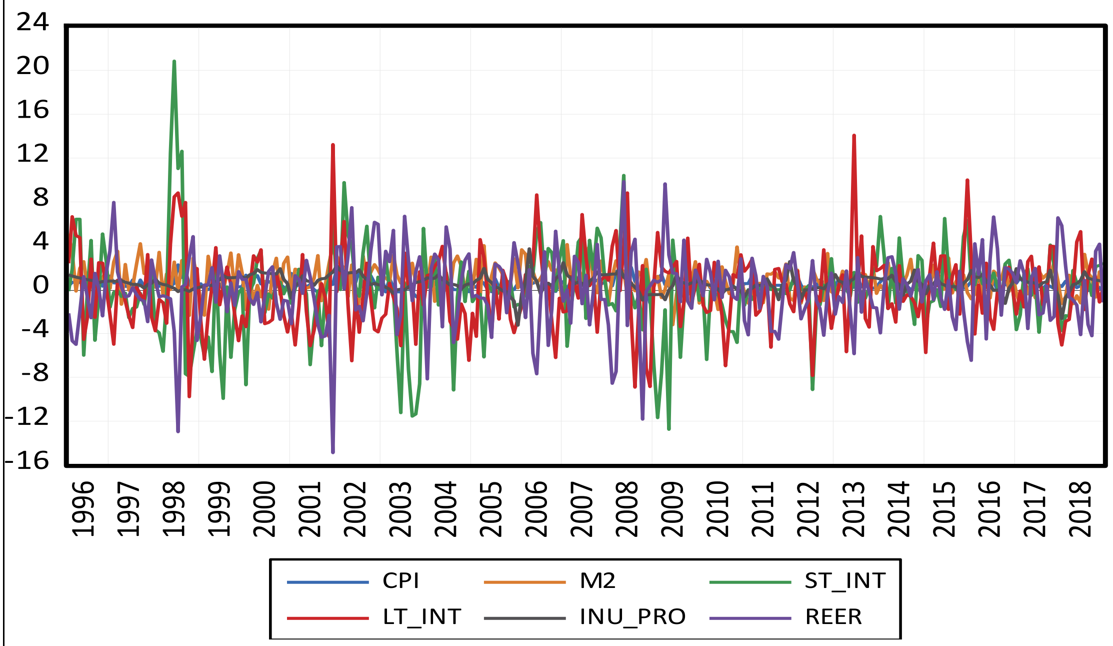
This section incorporates a graphical representation that considers a combination graph of the SA industry-based indices and the SA macroeconomic variables. Thereafter, the descriptive statistics of the JSE indices and macroeconomic variables are conducted. Moreover, the correlation analysis between the dependent and independent variables is illustrated to determine the association between the two sets of variables. Lastly, the ADF, PP, KPSS and ADF min-t break point tests is examined.

4.2.1. Graphical Representation

Figure 4.1 depicts the visual representation of the SA stock market indices and the SA macroeconomic factors. It contains a combination graph, which plots all dependent variables and independent variables of the study on a single graph to ascertain if there is a possible trend in the series and if the series attributed stationery properties.



(A)



(B)

Figure 4.1: Plot of the Stock Market Indices and Macroeconomic Variables
Data Source: Own Compilation

Figure 4.1 is the graphical representation of the transformed time series. Figure A graphically illustrates the JSE All-Share Index returns, Industrial Metals and Mining Index returns, Consumer Goods Index returns, Consumer Services Index returns, Telecommunications Index returns, Financials Index returns and Technologies Index returns. Figure B, on the other hand, graphically demonstrates the inflation growth rate, money supply growth rate, short-term interest growth rate, long-term interest growth rate, industrial production growth rate, growth rate of REER.

It is evident in both graphs (A and B) that the stock market returns series and macroeconomic variable series illustrated a white noise process. This was due to the non-existence of a trend among both series and each series was seen to cross its mean values frequently. According to Brooks (2014), if a series depicted a white noise process, then that series was regarded as stationary. This suggested that the series mean, variance and autocovariance were constant. Hence, when shocks are administered to the process, the stationery series allowed the shocks to fade away over time and did not alter the accuracy of the data (Granger, Hyung and Jeon, 2001). However, to confirm the stationarity of the stock market index series and macroeconomic series the ADF test, PP test and KPSS test is administered.

In addition to stock market index series and the macroeconomic series attributing stationary properties, it is evident from Figure 4.1 (A), that the Industrial Metal and Mining Index returns, Technologies Index returns and Financials Index returns had a high level of movement for the sample period relative to other stock market indices returns. Furthermore, the Industrial Metal and Mining Index returns attributed the largest deviations, followed by the Technologies Index returns and Financials Index returns. The high levels of movement in the three indices returns were conducive with a highly volatile stock market index. Thus, investors who are risk taking should consider investing in companies that form part of the Industrial Metal and Mining Index, Technologies Index and Financials Index. In Figure 4.1 (B), the short-term interest growth rate, long-term interest growth rate and growth rate of REER fluctuated highly for the sample period relative to other macroeconomic variables. This indicated that the SARB made regular changes to short-term interest growth rate, long-term interest growth rate and growth rate REER between 1996 and 2018. This was done to cater for the contagion effects of a democratic SA, 1997 Asia financial crises, 2000 SA inflation target regime, 2002 currency crisis and the 2008/2009 global financial crisis.

4.2.2. Descriptive Statistics Results

Tables 4.1 and 4.2 demonstrate the common sample descriptive statistics of the SA stock market indices and the SA macroeconomic variables. The common sample descriptive statistics is illustrated in each table, contain the sample mean, median, maximum, minimum, standard deviation, skewness, kurtosis, Jarque-Bera statistics and probability (p-values) of the JSE indices and macroeconomic variables, respectively.

4.2.2.1. Descriptive Statistics of Stock Market Indices Results

Table 4.1: Descriptive Statistics of JSE Indices Returns

	JSE_ALSI	**INU_IND**	**CONG_IND**	**CONS_IND**	**TELCOM_IND**	**FIN_IND**	**TECH_IND**
Mean	0.785	0.563	1.062	1.073	0.770	0.649	0.397
Median	0.781	0.333	1.207	1.487	0.669	0.705	1.053
Max.	14.005	72.679	19.595	15.695	32.792	22.744	30.420
Min.	-33.752	-58.234	-25.598	-39.523	-38.416	-50.056	-53.586
Std. Dev.	5.340	12.857	6.531	6.483	8.645	5.959	10.298
Skewness	-1.082	0.300	-0.607	-1.200	-0.142	-2.060	-1.194
Kurtosis	8.891	8.037	5.081	7.808	5.577	21.673	7.375
Jarque-Bera	451.253	294.829	66.515	320.339	77.019	4189.81	284.664
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	275	275	275	275	275	275	275

**Note: JSE_ALSI, INU_IND, CONG_IND, GONS_IND, TELCOM_IND, FIN_IND and TECH_IND are given to be the JSE All-Share Index returns, Industrial Metals and Mining Index returns, Consumer Goods Index returns, Consumer Services Index returns, Telecommunications Index returns, Financials Index returns and Technologies Index returns respectively. All figures are rounded off to 3 decimal places.*

Table 4.1 depicts the common sample descriptive statistics of the SA stock market indices. The Consumable Goods Index and the Consumables Service Index attained the highest average return for the sample period, whereas the Technologies Index demonstrated the lowest average returns. This indicated that the Consumable Goods Index returns and Consumable Service Index returns was over-performing with reference to the aggregated market (JSE All-Share Index returns) and the Technologies Index returns was underperforming with reference to the overall market. The Industrial Metals and Mining Index, Telecommunication Index and the Financials Index exhibited an average return similar to the overall market. This suggested the trend of the indices is similar to the aggregated market. It therefore implied that investors could gauge the performance of the Industrial Metals and Mining index, Telecommunication Index and the Financials Index by assessing the technical and fundamental analysis of the JSE All-Share Index.

Moreover, except for the Industrial Metal and Mining Index returns, the distribution of the JSE indices returns are negatively skewed. This demonstrated that the mean lies to the left of the median and mode. Hence, there existed more extreme negative returns than positive returns for the sample period of the study. The JSE indices returns reached an all-time low in 2008/2009 as seen by the extremely negative minimum values. This is attributed to the recession effect of the 2008/2009 global financial crises. The Industrial Metal and Mining Index returns was positively skewed and had the highest maximum returns and minimum returns for the sample period. This illustrated that the Industrial Metal and Mining Index returns was highly spread out and such a notion was supported by its high standard deviation. Given that the Industrial Metal and Mining Index returns fluctuated the most from all other JSE index returns. It indicated that the index was highly volatile as it attained the highest stand deviation. Investors should not invest in companies listed under the Industrial Metal and Mining Index as it was highly risky and the average returns was relatively low for the amount of risk acquired. Investors should rather invest in companies under the Consumable Goods Index, Consumable Service Index and the Financials Index as it contained low risk (standard deviation) and small fluctuations (maximum and minimum) in returns with a high average return.

The JSE indices returns above were leptokurtic distributed as they contained a kurtosis greater than 3. This indicated that the JSE indices returns did not have a normal bell curve as the returns peaked and flattened. The leptokurtic and negative skewness suggested that the JSE indices returns did not follow a normal distribution. The Jarque-Bera test of normality confirmed this as the null hypothesis (JSE indices returns were normally distributed) was rejected in favour of the alternative hypothesis (JSE indices returns were not normally distributed) at the 1 percent level of significance as indicated by the p-values. It was common sight among emerging stock markets that the market returns are not normally distributed as indicated by the negative skewness and excess kurtosis (Bekaert, Erb, Harvey and Viskanta, 1998). Given such findings among emerging stock market returns and the study’s large sample (275 observations), the violation of the normality assumptions was the least of the academic’s concern.

4.2.2.2. Descriptive Statistics of Macroeconomic Variables Results

Table 4.2: Descriptive Statistics of Macroeconomic Factors

	CPI	M2	ST_INT	LT_INT	INU_PRO	REER
Mean	0.475	0.914	-0.142	-0.074	0.615	-0.039
Median	0.403	0.959	0.000	-0.145	0.628	0.011
Max	2.266	5.103	20.833	14.079	3.727	9.857
Minimum	-1.216	-3.215	-12.732	-9.771	-3.243	-14.877
Std. Dev.	0.478	1.438	3.953	3.446	0.731	3.263
Skewness	0.569	0.081	0.259	0.514	-0.589	-0.543
Kurtosis	4.247	2.719	7.021	4.608	7.405	5.521
J-B	32.677	1.205	188.331	41.722	238.287	86.337
Prob.	0.000	0.547	0.000	0.000	0.000	0.000
Observations	275	275	275	275	275	275

**Note: CPI, M2, ST_INT, LT_INT, INU_PRO and REER are given to be growth in the inflation rate, broad money supply rate short-term interest rate, long-term interest rate, industrial production rate and REER respectively. All figures are rounded off to 3 decimal places.*

The descriptive statistics of the macroeconomic factors are reported in Table 4.2. The average growth for the inflation rate, money supply rate and industrial production rate was positive, whereas the average growth of short-term interest rate, long-term interest rate and REER was negative. Money supply had the highest average growth and short-term interest rate had the lowest average growth for the sample period. The findings for money supply illustrated an increase in the investment in marketable securities, saving deposits, mutual funds and other time deposits for the sample period. The negative average growth rates attained to interest rates (short-term interest rate, long-term interest rate and REER) is a direct result of the 2008/2009 global financial crisis where the SARB lowered interest rates to stimulate economic activity due to the negative effect posed by the financial crisis.

The inflation growth rate attained the lowest maximum, minimum and standard deviation values from all macroeconomic variables. The low maximum and minimum values suggested inflation growth rate did not fluctuate extensively, therefore, making it less volatile, which was supported by the low standard deviation. These low values attained to inflation growth rate indicated that the inflation-targeting policy that was imposed by the SARB in the market was robust and adequate for the SA economy. On the other hand, the growth rate of interest rates (short-term interest rate, long-term interest rate and REER) had the highest maximum, minimum and standard deviation values. The high maximum and minimum values showed that interest rates fluctuated greatly, therefore, it attained the highest standard deviation and negative average growth rate. As indicated above, this was owing to the attempt by the SARB to kickstart the SA economy due to negative effects of the 2008/2009 global financial crisis.

The inflation growth rate, money supply growth rate, short-term interest growth rate and long-term interest growth rate were positively skewed. However, growth rate of REER and industrial production growth rate was negatively skewed. The former (latter) indicated that the mean lies to the right (left) of the median and mode. Hence, there existed more extreme positive (negative) growth rates than negative (positive) growth rates. In addition, all macroeconomic factors, except for money supply growth rate indicated a kurtosis greater than three, this suggested that the growth rate of macroeconomic variables followed a leptokurtic distribution, whereas the growth rate of money supply followed a mesokurtic distribution. The skewness and kurtosis of inflation growth rate, short-term interest growth rate, long-term interest growth rate, industrial production growth rate and growth rate of REER suggested that these macroeconomic variables did not follow a normal distribution. The Jarque-Bera test of normality confirmed this as the null hypothesis was rejected at the 1 percent level of significance. However, for the money supply growth rate, the study failed to reject the null and confirmed that money supply growth rate was normally distributed as supported by its kurtosis value of less than three.

4.2.3. Correlation Analysis Results

Table 4.3 depict the cross-correlation coefficients of the SA stock market indices and the SA macroeconomic variables. The correlation analysis was conducted to determine if the JSE index returns had significant, insignificant, positive or negative association with the macroeconomic factors. It was essential to determine if a relationship existed between the two sets of variables as it served as confirmation to proceed with the estimation of the Markov regime-switching model of conditional mean with fixed transition probabilities. The correlation test was run using the ordinary method and probability test statistics.

Table 4.3: Correlation Analysis of JSE Indices Returns and Macroeconomic Factors

	JSE_ALSI	INU_IND	CONG_IND	CONS_IND	TELCOM_IND	FIN_IND	TECH_IND
CPI	-0.132** (0.029)	0.147** (0.012)	-0.128** (0.034)	-0.180*** (0.003)	-0.064 (0.287)	-0.061 (0.315)	-0.072 (0.234)
M2	0.009 (0.876)	-0.097 (0.109)	0.039 (0.524)	-0.053 (0.383)	0.015 (0.800)	-0.022 (0.723)	-0.012 (0.848)
ST_INT	-0.211*** (0.000)	-0.006 (0.915)	-0.119** (0.049)	-0.238*** (0.000)	-0.204*** (0.000)	-0.24*** (0.000)	-0.065 (0.286)
LT_INT	-0.209*** (0.000)	-0.038 (0.5327)	-0.060 (0.3181)	-0.361*** (0.00)	-0.343*** (0.00)	-0.356*** (0.00)	-0.094 (0.121)
INU_PRO	0.027 (0.652)	0.097 (0.108)	0.034 (0.580)	-0.093 (0.126)	-0.002 (0.978)	-0.040 (0.508)	-0.050 (0.407)
REER	0.054 (0.374)	0.087 (0.151)	-0.052 (0.391)	0.194*** (0.001)	0.203*** (0.000)	0.195*** (0.001)	0.027 (0.651)

Note: The correlation coefficient test is estimated using the ordinary method with probability test statistics. The parenthesis indicates the p-values, whereas *, ** and *indicate a 1%, 5% and 10% level of significance respectively. All figures are rounded off to 3 decimal places.*

It is noted in Table 4.3 that the coefficients associated with all JSE index returns are negative for inflation growth rate, only the JSE All-Share Index returns, Industrial Metal and Mining Index returns and Consumable Goods Index returns are statistically significant at a 5 percent level of significance. However, Consumable Service Index returns are statically significant at a 1 percent level of significance. This indicates that there existed a significant negative association between inflation growth rate and JSE All-Share Index returns, Industrial Metals and Mining Index returns, Consumable Goods Index returns and Consumable Service Index returns. Thus, such was constant with the hypothesised association in the empirical literature between stock market returns and inflation (Cifter, 2017). The coefficients associated with each JSE index returns for money supply growth rate were statistically insignificant. However. The positive (negative) coefficients indicate that the JSE All-Share Index returns, Consumable Goods Index returns and Telecommunication Index returns (the Industrial Metal and Mining Index returns, Consumable Service Index returns, Financials Index returns and Technologies Index returns) had an insignificant positive (negative) association with money supply growth rate. The mixed findings seen for money supply growth rate were consistent with the empirical literature, as it was found that the association between money supply on stock market returns was an empirical one (Fama, 1981)

The coefficients associated with all JSE index returns are negative for short-term interest growth rate, only the JSE All-Share Index returns, Consumable Service Index returns Telecommunication Index returns and Financials Index, returns were statistically significant at a 1 percent level of significance. However, Consumable Goods Index returns was statically significant at 5 percent level of significance. This indicated that there existed a significant negative association between short-term interest growth rate and the JSE All-Share Index returns, Consumable Service Index returns, Telecommunication Index returns, Financials Index returns and Consumable Goods Index returns. The negative coefficients were also evident for long-term interest growth rate. However, only the JSE All-Share Index returns, Consumable Service Index returns, Telecommunication Index returns and Financials Index returns had a significant association with long-term interest growth rate. The findings were consistent with the empirical literature, as the hypothesised association between stock market reruns and interest rates was negative (Dhlamini, 2017).

The coefficients of industrial production growth rate for each JSE index returns were insignificant. However, JSE All-Share Index returns, Industrial Metal and Mining Index returns and Consumable Goods Index returns (the Consumable Service Index returns, Telecommunication Index returns, Financials Index returns and the Theologies Index returns) had an insignificant positive (negative) association with industrial production growth rate. In addition, the coefficients associated with the growth rate of REER for each JSE index returns, with exception of Consumable Goods Index returns were positive. It was seen that Consumable Service Index returns, Telecommunication Index returns and Financials Index returns were statically significant at a 1 percent level of significance. Hence, the Consumable Service Index returns, Telecommunication Index returns, Financials Index returns had a significant positive association with the real effective exchange growth rate. The findings were consistent with the hypothesised association evident in the empirical literature (Zhao, 2010).

4.2.4. Unit Root and Stationarity Tests Results

Table 4.3 illustrates the unit root tests and stationarity tests of the SA stock market indices and Table 4.4 demonstrates the unit root tests and stationarity tests of the SA macroeconomic variables. The unit root tests were given by the ADF test and PP test and the stationery tests were given by the KPSS test. In addition to the unit root tests and the stationarity test, the ADF min-t breakpoint unit root test with an innovation outlier was estimated to determine if the data were stationary with structural breaks. The standard and breakpoint ADF test was run with a maximum of 15 lags as given by SBIC. The PP and KPSS tests were estimated with the Bartlett Kernel spectral estimation method and Newey-West bandwidth method. In both instances of estimating the unit root, stationarity tests and break point tests were run in levels and with an intercept. The use of an intercept was attributed to the graphical representation in Section 4.2.1, which found the nonexistence of a trend in the JSE indices returns series and macroeconomic variables series.

4.2.4.1. Results of Unit Root Tests for Stock Market Indices

Table 4.4: The ADF, PP and KPSS Test of the JSE Indices Returns

JSE INDEX	ADF TEST	PP TEST	KPSS TEST
Unit Root and Stationarity Tests in Levels with an Intercept			
JSE_ALSI	-17.028*** (0.00)	-17.057*** (0.00)	0.087***
INU_IND	-9.977*** (0.00)	-16.386*** (0.00)	0.117***
CONG_IND	-18.030*** (0.00)	-18.027*** (0.00)	0.139***
CONS_IND	-14.547*** (0.00)	-14.434*** (0.00)	0.327***
TELCOM_IND	-15.618*** (0.00)	-15.640*** (0.00)	0.120***
FIN_IND	-16.416*** (0.00)	-16.536*** (0.00)	0.055***
TECH_IND	-14.608*** (0.00)	-14.640*** (0.00)	0.134***
Break Point Unit Root Test in Levels with an Intercept			
JSE_ALSI	-18.271*** (<0.01)	N/A	
INU_IND	-16.470*** (<0.01)		
CONGIND	-18.744*** (<0.01)		
CONS_IND	-15.930*** (<0.01)		
TELCOM_IND	-16.164*** (<0.01)		
FIN_IND	-16.968*** (<0.01)		
TECH_IND	-15.740*** (<0.01)		

Note: The parenthesis indicates the p-values associated with the ADF and PP test whereas *, ** and * indicate a 1%, 5% and 10% level of significance respectively. The LM critical values of the KPPS test is: 1% = 0.739, 5% = 0.463, 10% = 0.347. All figures are rounded off to 3 decimal places.*

It is seen in Figure 4.4 that test statistic of the ADF and PP (unit root tests) test was more negative than the critical values at a 1 percent level of significance. This allowed for the rejection of the null hypothesis that the JSE indices returns contained a unit root, in favour of the alternative hypothesis that the JSE indices returns were stationery. The stationery test of

KPSS confirmed the findings of the unit root tests for all indices. The KPSS test statistic of the JSE indices were smaller than the critical values at the 1 percent level of significance. Hence, the study failed to reject the null hypothesis that the JSE indices returns were stationary. The break point unit root test confirmed the stationery of the JSE indices returns in the presence of structural breaks. The null hypothesis of a unit root was rejected in favour of the alternative hypothesis of stationarity, as the test statistic was more negative than the critical values at a 1 percent level of significance. The study concluded that the JSE indices returns (JSE All-Share Index returns, Industrial Metals and Mining Index returns, Consumer Goods Index returns, Consumer Services Index returns, Telecommunications Index returns, Financials Index returns and Technologies Index returns) were stationery in levels as well as when structural breaks were evident.

4.2.4.2. Results of Unit Root Tests for Macroeconomic Variables

Table 4.5: The ADF, PP and KPSS Test of the Macroeconomic Factors

Macroeconomic Factor	ADF TEST	PP TEST	KPSS TEST
Unit Root and Stationarity Tests in Levels with an Intercept			
CPI	-12.135*** (0.00)	-12.135*** (0.00)	0.118***
M2	-17.724*** (0.00)	-17.685*** (0.00)	1.095
ST_INT	-10.828*** (0.00)	-10.810*** (0.00)	0.0928***
LT_INT	-12.881*** (0.00)	-12.562*** (0.00)	0.171***
INU_PRO	-3.336** (0.01)	-7.298*** (0.00)	0.247***
REER	-12.714*** (0.00)	-13.638*** (0.00)	0.069***
Break Point Unit Root Test in Levels with an Intercept			
CPI	-12.638*** (<0.01)	N/A	
M2	-18.981*** (<0.01)		
ST_INT	-11.820*** (<0.01)		
LT_INT	-13.317*** (<0.01)		
INU_PRO	-7.506*** (<0.01)		
REER	-14.073*** (<0.01)		

Note: The parenthesis indicates the p-values associated with the ADF and PP test whereas *, ** and * indicate a 1%, 5% and 10% level of significance respectively. The LM critical values of the KPPS test is: 1% = 0.739, 5% = 0.463, 10% = 0.347. All figures are rounded off to 3 decimal places.*

In Figure 4.5 the ADF test statistic of the macroeconomic variables, with the exception of industrial production growth rate, was more negative than the critical values. This allowed for the null hypothesis (macroeconomic variables contained a unit root) to be rejected in favour of the alternative hypothesis (macroeconomic variables were stationary) at a 1 percent level of significance. However, for industrial production growth rate, the study rejected the null hypothesis at a 5 percent level of significance. The PP test confirmed the ADF test as all macroeconomic variables test statistics were more negative than the critical values at a 1 percent level of significance. This allowed for the null hypothesis: macroeconomic variables contained a unit root to be rejected in favour of the alternative hypothesis: macroeconomic variables were stationery. The unit root tests of ADF and PP confirmed all macroeconomic variables were stationery in levels.

The stationarity tests given by KPSS were also confirmed by the findings of the ADF test and PP test for all macroeconomic variables except money supply growth rate. The money supply growth rate demonstrated test statistics that were larger than the critical values at a 1 percent level of significance. The study, therefore, rejected the null hypothesis that money supply growth rate was stationery and concluded that all macroeconomic variables, with exception of money supply growth rate were stationery in levels. The break point unit root test confirmed stationery of the macroeconomic variables in the presence of structural breaks. The null hypothesis of a unit root was rejected in favour of the alternative hypothesis of stationarity as the test statistic was more negative than the critical values at a 1 percent level of significance.

It was evident for all macroeconomic variables, with the exception of industrial production growth rate and money supply growth rate, that the ADF, PP, KPSS and ADF min-t test confirmed stationarity. However, the ADF, PP and ADF min-t test (PP, KPSS and ADF min-t test) confirmed money supply growth rate (industrial production growth rate) is stationery. Hence, the study concluded, as per the confirmation analysis, the inflation growth rate, money supply rate growth rate, short-term interest rate growth rate, long-term interest rate growth rate, industrial production growth rate and growth rate of REER were stationery at levels and in the presence of structural breaks.

An important requirement by the Markov regime-switching model of conditional mean with constant transition probabilities was the presence of stationarity with structural breaks in the data series (Paliouras, 2007). The model assumed that the transition probabilities are constant throughout time (Hamilton, 1989). This indicated that the model was biased to estimations that contain data that was non-stationery with structural breaks, as the model did not cater for the break periods in the non-stationary series. Hence, the estimates were inefficient of which the estimated outputs contained incorrect and unmeasurable conclusions (Paliouras, 2007). Having found the data series to be stationery in the presence of structural breaks, the study proceeds by estimating the Markov regime-switching model of conditional mean with constant transition probabilities.

4.3. Empirical Model Analysis

In this section, the Markov regime-switching model of conditional mean with constant transition probabilities is demonstrated and interpreted accordingly. The section is outlined as follows: Section 3.5 contains the results of the Markov regime-switching model and interpretation. Thereafter, the summary of findings is presented and a discussion of the results is conducted in Section 3.6. Lastly, in Section 4.7, the chapter summary is presented, which entails a synthesis of the findings of the chapter.

4.4. Markov Regime-Switching Model of Conditional Mean

Having found the variables to be stationary in levels and with structural breaks in the previous section, the next step was to estimate the Markov regime-switching model of conditional mean to determine how the SA macroeconomic variables affected the SA stock index returns. The Markov regime-switching model had been estimated to cater for two states, namely a bull market condition (regime 1) and bear market condition (regime 2). In this model, the macroeconomic regressors, the mean and the error variance of the SA stock index returns were subject to switches between regimes. Thus, in a bull market, the macroeconomic regressors, the mean and the error variance of the SA stock index returns were different from that of a bear market condition. Equations 16 to 22 in Chapter 3 were estimated and consisted of the Markov regime-switching model of stock index returns with two states and varying macroeconomic regressors, mean and error variance.

4.5. Empirical Estimation and Results

The Markov regime-switching model of condition mean is expressed in Section 4.5.1 and interpreted accordingly. In Section 4.5.2, the JSE industry-based indices transition probabilities and the constant expected duration is represented and an interpretation is conducted. Lastly, Section 4.5.3 contains the graphical representation of the smooth transition probabilities of each JSE industry-based index and a discussion.

4.5.1. Markov Regime-Switching Model of Conditional Mean Results

The study estimated the empirical model and represented it herein as it allowed for the examination of objective one and two. Hence, the estimated output of the empirical model and the residual diagnostic tests in the form of a normality test was explored. The tables in this section comprise of three panels. Panel one and two are the states, that being, a bull and bear market condition, whereas panel three is the residual diagnostic tests for each model. Thus, μ, is the mean of the JSE index returns, α_0 is inflation growth rate, α_1 is money supply growth rate, α_2 is short-term interest rate growth rate, α_3 is long-term interest growth rate, α_4 is industrial production growth rate, α_5 is the growth rate of REER and σ^2 is the error variance.

4.5.1.1. The JSE All-Share Index Regime-Switching Results

Table 4.6: JSE_ALSI Markov Regime-Switching Model of Conditional Mean

$$JSE\_ALSI = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta LT\_INT + \alpha_{4ict}\Delta INU\_PRO + \alpha_{5ict}\Delta REER + \varepsilon_{c_t,}$$

JSE All-Share Index			
Regime 1: Bull Market Condition			
Independent Variable	**Coefficient**	**z-Statistic**	**Prob.**
μ	1.317***	2.644	0.008
α_0	-0.459	-0.609	0.543
α_1	-0.030	-0.151	0.880
α_2	-0.004	-0.036	0.971
α_3	-0.323***	-2.871	0.004
α_4	0.040	0.108	0.914
α_5	-0.109	-0.916	0.359
σ^2	1.225***	20.628	0.000
Regime 2: Bear Market Condition			
μ	-1.224	-0.864	0.388
α_0	-1.152	-0.821	0.412
α_1	0.256	0.499	0.618
α_2	-0.397**	-2.478	0.013
α_3	-0.183	-0.771	0.441
α_4	2.161*	1.876	0.062
α_5	0.006	0.030	0.976
σ^2	1.953***	24.544	0.000
Residual Diagnostic Test			
Normality Test			
Jarque-Bera	90.857	-	0.00

Note: *, ** ,and * indicate a 1%, 5% and 10% level of significance respectively All figures are rounded off to 3 decimal places.*

Bull and Bear Market Condition in the JSE All-Share Index

Table 4.6, panels one and two display the bear market condition and bull market condition of the JSE All-Share Index returns. The intercepted (μ) was indicative of the JSE All-Share Index returns in an upper and lower market conditions. It was evident when the JSE All-Share Index returns were in a bull market condition the returns attained was statically significant at a 1 percent level of significance and higher than that of the bear market condition. The error variance (σ^2) associated with the bull and bear market conditions of the JSE All-Share Index returns was significant and higher in a bear market condition. Thus, the bear market condition returns were more volatile as the JSE All-Share Index returns fluctuated more during a bearish market condition as opposed in a bullish market condition. This was expected as in a bull (bear) market conditions the returns of a stock index were increasing (decreasing) over time (Naicker, 2017).

In Table 4.6, panel one, the coefficients of industrial production growth rate (α_4) was positive, whereas the coefficients associated with inflation growth rate (α_0), money supply growth rate (α_1), short-term interest growth rate (α_2), long-term interest growth rate (α_3) and growth rate of REER (α_5) were negative, long-term interest growth rate was statically significant at a 1 percent level of significance. The findings indicated long-term interest growth rate had a significant negative effect on JSE All-Share Index returns in a bull market condition. Thus, a 1 percent increase or decrease in long-term interest growth rate will cause a decrease in the JSE All-Share Index returns by 0.323 percent, *ceteris paribus*.

In Table 4.6, panel two, the coefficients of money supply growth rate (α_1), industrial production growth rate (α_4) and growth rate of REER (α_5) were positive, industrial production growth rate was statically significant at a 10 percent level of significance. Thus, industrial production growth rate had a significant positive effect on JSE All-Share Index returns in a bear market condition. The coefficients of inflation growth rate (α_0), short-term interest growth rate (α_2) and long-term interest growth rate (α_3) were negative, short-term interest growth rate was statically significant at a 5 percent level of significance. Hence, a 1 percent increase or decrease in short-term interest growth rate will cause the JSE All-Share Index returns to decrease by 0.397 percent in a bearish market condition, *ceteris paribus*.

When a comparison was conducted between the bull and bear regimes, the coefficients of money supply growth rate and growth rate of REER were negative in a bullish market condition and positive in the bearish market condition. Furthermore, long-term interest growth rate was significant in a bull regime but insignificant in a bear regime and industrial production growth rate and short-term interest growth rate was significant in a bear regime but insignificant in a bull regime. The findings suggested macroeconomic variables effected the JSE All-Share Index returns differently in an upper and lower market condition. This confirmed the AMH theory, as alternating efficiency and affects were presented in the JSE All-Share Index returns (Lo, 2004). In answering research objective one and two, the JSE All-Share Index returns was significantly negatively affected by long-term interest growth rate in a bullish market condition, significantly negatively affected by the short-term interest growth rate in bearish market condition and significantly positively affected by industrial production growth rate in a bearish market condition.

Residual Diagnostic Test: Jarque-Bera Normality Test

In Table 4.6, panel 3, the Jarque-Bera normality test is presented together with the Jarque-Bera statistic and the p-value. It was evident that the p-value associated with the Jarque-Bera statistic was 0.00. This allowed for the rejection of the null hypothesis: residuals were normally distributed, in favour of the alternative hypothesis: residuals were not normally distributed, at a 1 percent level of significance. The study confirmed departure from normality in the residuals of the estimated model given by Equation 6.

In a study conducted by Campbell (2002), the normality assumption regarding regime-switching models was inconstant. It was found when there existed a two-state regime with a high volatility state the normality assumption was violated. This was owing to the volatile regime containing a distribution that was negatively skewed and leptokurtic regarding the normal distribution (Campbell. 2002). Thus, the departure from normality in a two-regime model with a high volatile regime was evident and did not affect the efficiency of the output. Given that the bear market condition was categorised by a decrease in returns (contain negative returns, hence it was negatively skewed, refer to Section 4.2.2.1). The study considered such regime as a high volatile regime, as it was found above that the bearish market condition (error variance (σ^2)) was more volatile than the bullish market condition due to the categorisation of the index returns when placed in a lower market condition. Furthermore, studies by Maheu and McCurdy (2000) and Cunado, Gil-Alana and de Gracia (2009) considered the bear market condition as a volatile regime. Thus, if the Jarque-Bera normality test found departure from normality in the estimated residuals, such an explanation was relevant.

4.5.1.2. The Industrial Metal and Mining Index Regime-Switching Results

Table 4.7: INU_IND Markov Regime-Switching Model of Conditional Mean

$INU\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta LT\_INT + \alpha_{4ict}\Delta INU\_PRO + \alpha_{5ict}\Delta REER + \varepsilon_{c_t}$			
Industrial Metal and Mining Index			
Regime 1: Bull Market Condition			
Independent Variable	**Coefficient**	**z-Statistic**	**Prob.**
μ	1.398	1.240	0.215
α_0	-0.094	-0.061	0.951
α_1	-0.742	-1.637	0.102
α_2	-0.075	-0.381	0.703
α_3	0.124	0.551	0.582
α_4	0.172	0.189	0.850
α_5	-0.015	-0.062	0.951
σ^2	2.182***	39.545	0.000
Regime 2: Bear Market Condition			
μ	-15.371*	-1.960	0.050
α_0	15.304**	1.975	0.048
α_1	-1.270	-0.531	0.596
α_2	0.696	0.759	0.448
α_3	-1.589	-1.095	0.274
α_4	9.873	1.611	0.107
α_5	-0.019	-0.016	0.987
σ^2	3.044***	24.969	0.000
Residual Diagnostic Test			
Normality Test			
Jarque-Bera	115.127***	-	0.00

Note: *, ** and * indicate a 1%, 5% and 10% level of significance respectively. All figures are rounded off to 3 decimal places.*

Bull and Bear Market Condition in the Industrial Metal and Mining Index

In Table 4.7, panel one and two, the returns (μ) of the Industrial Metal and Mining Index in a bull market condition was 1.398 percent whereas in a bear market condition it was -15.371 percent. The bear market condition returns were statistically significant at a 10 percent level of significance. The positive, negative and statically significant coefficient indicated that the Industrial Metal and Mining Index returns was positive in the presence of a bull market condition and negative in a bear market condition. However, Industrial Metal and Mining Index returns was statistically significant at a 1 percent level of significance and indicated the bear market condition (σ^2=3.044 percent) was more volatile than that of the bull market condition

(σ^2=2.182 percent). These findings were in line with the empirical literature, as stock market returns were increasing during an upper market condition and decreasing in a lower market condition (Jhamb, Dhaiya and Menani, 2019). Hence, the positive and negative returns and lower and higher volatility.

In Table 4.7 panel one, when the Industrial Metal and Mining Index returns was in a bull market condition, no macroeconomic variables were significant. However, the coefficients of long-term interest growth rate (α_3) and industrial production growth rate (α_4) were positive, whereas the coefficients associated with inflation growth rate (α_0), money supply growth rate (α_1), short-term interest growth rate (α_2) and growth rate of REER (α_5) were negative.

In Table 4.7, panel two, when the Industrial Metal and Mining Index returns was in a bear market condition, the coefficients of inflation growth rate (α_0), short-term interest growth rate (α_2) and industrial production growth rate (α_4) were positive, inflation growth rate was statically significant at a 5 percent level of significance. Furthermore, when Industrial Metal and Mining Index returns was in a bear market condition, the coefficients of money supply growth rate (α_1), long-term interest growth rate (α_3) and growth rate of REER (α_5) was negative. Thus, the Industrial Metal and Mining Index returns was significantly positively affected by inflation growth rate in a bearish market condition. Hence, if the inflation growth rate was said to fluctuate, the Industrial Metal and Mining Index returns will increase by 15.371 percent, *ceteris paribus*.

It is seen where long-term interest growth rate (inflation growth rate and short-term interest growth rate) coefficients were positive (negative) in a bull market condition, they were negative (positive) in the bear market condition. In addition, inflation growth rate was found to be significant in a bear market condition but insignificant in a bull market condition. This confirmed the alternating effect between market conditions as proposed by AMH (Lo, 2004). When answering research objectives one and two, Industrial Metal and Mining returns were only significantly positively affected by inflation (CPI) growth rate in a bear market condition.

Residual Diagnostic Test: Jarque-Bera Normality Test

In Table 4.7, panel three, the Jarque-Bera normality test is presented together with the Jarque-Bera statistic and the p-value. It was evident that the p-value associated with the Jarque-Bera statistic was 0.00. This allowed for the rejection of the null hypothesis: residuals were normally distributed, in favour of the alternative hypothesis: residuals were not normally distributed, at a 1 percent level of significance. The study confirmed departure from normality in the residuals of the model given by Equation 7.

4.5.1.3. The Consumable Goods Index Regime-Switching Results

Table 4.8: CONG_IND Markov Regime-Switching Model of Conditional Mean

$CONG\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta LT\_INT + \alpha_{4ict}\Delta INU\_PRO + \alpha_{5ict}\Delta REER + \varepsilon_{c_t,}$			
Consumable Goods Index			
Regime 1: Bull Market Condition			
Independent Variable	**Coefficient**	**z-Statistic**	**Prob.**
μ	1.329*	1.899	0.058
α_0	0.325	0.314	0.754
α_1	0.4274	1.310	0.190
α_2	0.083	0.890	0.373
α_3	-0.051	-0.367	0.714
α_4	-0.001	-0.002	0.998
α_5	0.460***	3.198	0.001
σ^2	0.958***	6.773	0.000
Regime 2: Bear Market Condition			
μ	0.729	0.619	0.536
α_0	-2.421*	-1.728	0.084
α_1	-0.032	-0.072	0.942
α_2	-0.375*	-1.908	0.056
α_3	-0.137	-0.560	0.576
α_4	1.003	0.988	0.323
α_5	-0.517**	-2.179	0.029
σ^2	2.020***	29.091	0.000
Residual Diagnostic Test			
Normality Test			
Jarque-Bera	24.279***	-	0.00

Note: *, ** and * indicate a 1%, 5% and 10% level of significance respectively. All figures are rounded off to 3 decimal places.*

Bull and Bear Market Condition in the Consumable Goods Index

In Table 4.8, panel one and two, the returns (μ) of Consumable Goods Index in a bull market condition was 1.329 percent, whereas in a bear market condition the returns were 0.729 percent. The bear market condition returns were statistically significant at 10 percent level of significance. The positive and statically significant coefficient indicated that Consumable Goods Index returns was positive in the presence of a bull and bear market conditions. Furthermore, the Consumable Goods Index return was significantly more volatile in the bear market condition (σ^2=2.020 percent) as opposed to the bull market condition (σ^2=0.958 percent). These findings suggested that Consumable Goods Service Index returns was positive when the returns were increasing (bull market condition) or decreasing (bear market condition), which suggested that there existed more positive returns for the Consumable Goods Index irrespective of the type of market condition that existed. However, the returns were more unstable in the bear market condition irrespective of the positive return on the investment.

In Table 4.6, panel one, the coefficients of inflation growth rate (α_0), money supply growth rate (α_1), short-term interest growth rate (α_2) and growth rate of REER (α_5) were positive, only growth rate of REER was statically significant at a 1 percent level of significance. The coefficients associated with short-term interest growth rate (α_3) and industrial production growth rate (α_4), were negative. This indicated that the Consumable Service Index returns in a bull market condition were significantly positively affected by the growth rate of REER . Thus, the Consumable Service Index returns in a bull market condition will increase by 0.460 percent if the growth rate of REER fluctuated from its real value, *ceteris paribus*.

In Table 4.6, panel two, the coefficients of industrial production growth rate (α_4) were positive and the coefficients of inflation growth rate (α_0), money supply growth rate (α_1), short-term interest growth rate (α_2), long-term interest growth rate (α_3) and growth rate of REER (α_5) were negative. It is further seen that the growth rate of REER was statistically significant at a 5 percent level of significance and inflation growth rate and short-term interest rate were statistically significant at a 10 percent level of significance. Thus, in a bear market condition, the returns of Consumable Goods Index were significantly positively affected by industrial production growth rate, whereas Consumable Goods Index returns were significantly negatively affected by inflation growth rate and short-term interest growth rate.

When a review was conducted between the bull and bear market conditions, it was seen that the coefficients of inflation growth rate, money supply growth rate, short-term interest growth rate, growth rate of REER (industrial production growth rate) were positive (negative) in an upper market condition and negative (positive) in a lower market condition. In addition, inflation growth rate and short-term interest growth rate were found to be significant in a bear market regime but insignificant in a bull market regime. Thus, EMH did not surface well as there existed alternating efficiencies and effects under changing market conditions, which was refuted by EMH (Fama, 1965). The study was consistent with AMH as the Consumable Goods Index returns were significantly positively affected by growth rate of REER in a bullish market condition and significantly negatively affected by the inflation (CPI) growth rate and short-term interest growth rate in a bearish market condition.

Residual Diagnostic Test: Jarque-Bera Normality Test

In Table 4.8, panel 3, the Jarque-Bera normality test is presented together with the Jarque-Bera statistic and the p-value. It was evident that the p-value associated with the Jarque-Bera statistic were 0.00. This allowed for the rejection of the null hypothesis: residuals were normally distributed, in favour of the alternative hypothesis: residuals were not normally distributed, at a 1 percent level of significance. The study confirmed departure from normality in the residuals of the model given by Equation 8.

4.5.1.4. The Consumable Service Index Regime-Switching Results

Table 4.9: CONS_IND Markov Regime-Switching Model of Conditional Mean

$$CONS\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta LT\_INT + \alpha_{4ict}\Delta INU\_PRO + \alpha_{5ict}\Delta REER + \varepsilon_{c_t,}$$			
Consumable Service Index			
Regime 1: Bull Market Condition			
Independent Variable	**Coefficient**	**z-Statistics**	**Prob.**
μ	0.327	0.091	0.928
α_0	-2.501	-0.743	0.457
α_1	-0.271	-0.364	0.716
α_2	-0.563*	-1.774	0.076
α_3	-0.960	-1.186	0.236
α_4	-0.576	-0.366	0.714
α_5	-0.992	-0.906	0.365
σ^2	2.017***	20.541	0.000
Regime 2: Bear Market Condition			
μ	2.805***	3.711	0.000
α_0	-1.831	-1.023	0.306
α_1	-0.141	-0.314	0.753
α_2	0.021	0.182	0.855
α_3	-0.373*	-1.891	0.059
α_4	-0.234	-0.254	0.799
α_5	0.323	1.478	0.140
σ^2	1.549***	6.874	0.000
Residual Diagnostic Test			
Normality Test			
Jarque-Bera	24.022***	-	0.00

Note: *, ** and * indicate a 1%, 5% and 10% level of significance respectively. All figures are rounded off to 3 decimal places.*

Bull and Bear Market Condition in the Consumable Service Index

In Table 4.9 panel one and two, the returns (μ) of the Consumable Service Index in a bear market condition (2.805 percent) was higher than the returns in the bull market condition (0.327 percent), with the bear market condition only exhibiting a statistically significant coefficient at a 1 percent level of significance. However, the high returns came with taking on a higher risk, therefore, the Consumable Service Index returns in a bull market condition (σ^2=2.017 percent (Significant at a 1 percent level of significance)) was more volatile than the returns in a bear market condition (σ^2=1.549 percent (significant a 1 percent level of significance)). Thus, investors who are risk taking and incorporated companies listed under the Consumable Service Index in their portfolio, earned a return on their investment of approximately 0.327 percent and 2.017 percent in a bull and bear market conditions respectively. Hence, a high return was earned in a bear market condition.

It was noted in Table 4.9 panel one, that the coefficients of all macroeconomic variables in a bull market condition were found to be negative with only short-term interest growth rate (α_2) being statistically significant at a 10 percent level of significance. Thus, Consumable Service Index returns was significantly negatively affected by short-term interest growth rate, as the Consumable Service Index returns will decrease by 0.563 percent in a bull market condition, if the short-term interest growth rate fluctuated, *ceteris paribus*.

In Table 4.9 panel two, the coefficients of short-term interest growth rate (α_2) and growth rate of REER (α_5) were positive. However, the coefficients for inflation growth rate (α_0), money supply growth rate (α_1), long-term interest growth rate (α_3), industrial production growth rate (α_4), were negative, long-term interest growth rate was statistically significant at a 10 percent level of significance. This suggested that long-term interest growth rate had a significant negative affect on Consumable Service Index returns in the bear market condition. Thus, a 1 percent increase or decrease in the long-term interest growth rate will cause the Consumable Service Index returns to decrease by 0.373 percent, *ceteris paribus*.

The findings show where coefficients of short-term interest growth rate and growth rate of REER were negative in a bullish market condition, they were positive in a bearish market condition. Furthermore, where short-term interest growth rate was significant in a bull regime, it was insignificant in a bear regime and where long-term interest growth rate was significant in a bear regime it was insignificant in a bull regime. This indicated that the effects of macroeconomic variables on the SA stock market returns was regime-dependent and varied according to the market condition. Thus, the notion proposed by AMH of alternating efficiency and inefficiency was presented in the Consumable Service Index returns (Lo, 2004). Hence, Consumable Service Index returns were significantly negatively affected by short-term interest growth rate in a bull market condition and long-term interest growth rate in a bear market condition

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Residual Diagnostic Test: Jarque-Bera Normality Test

In Table 4.10, panel 3, the Jarque-Bera normality test is presented together with the Jarque-Bera statistic and the p-value. It was evident that the p-value associated with the Jarque-Bera statistic was 0.00. This allowed for the rejection of the null hypothesis: residuals were normally distributed, in favour of the alternative hypothesis: residuals were not normally distributed, at a 1 percent level of significance. The study confirmed departure from normality in the residuals of the estimated Equation 9.

4.5.1.5. The Telecommunication Index Regime-Switching Results

Table 4.10: TELCOM_IND Markov Regime-Switching Model of Conditional Mean

$$TELCOM\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta LT\_INT + \alpha_{4ict}\Delta INU\_PRO + \alpha_{5ict}\Delta REER + \varepsilon_{c_t,}$$			
Telecommunication Index			
Regime 1: Bull Market Condition			
Independent Variable	**Coefficient**	**z-Statistic**	**Prob.**
μ	0.336	0.393	0.694
α_0	0.063	0.051	0.960
α_1	0.497	1.571	0.116
α_2	-0.197	-1.296	0.195
α_3	-0.445**	-2.524	0.012
α_4	0.103	0.165	0.869
α_5	0.333**	2.156	0.031
σ^2	1.819***	17.839	0.000
Regime 2: Bear Market Condition			
μ	-5.352	-0.764	0.445
α_0	2.510	-0.641	0.717
α_1	-1.471	0.013	0.521
α_2	0.008	-1.836	0.990
α_3	-2.104*	1.052	0.066
α_4	6.689	-0.473	0.293
α_5	-0.853	-0.641	0.636
σ^2	2.646***	15.634	0.000

Residual Diagnostic Test			
Normality Test			
Jarque-Bera	40.518***	-	0.00

Note: *, ** and * indicate a 1%, 5% and 10% level of significance respectively. All figures are rounded off to 3 decimal places.*

Bull and Bear Market Condition in the Telecommunication Index

In Table 4.10, panel one and two, the returns (μ) of the Telecommunication Index in a bull and bear market conditions was statically insignificant. However, the error variance associated with the bull market condition (1.819 percent) and bear market condition (2.646) was significant at a 1 percent level of significance. This indicated that the Telecommunication Index returns was more volatile in a bear market condition as opposed to the bull market condition. This was consistent with theory as stock market returns were said to decrease in a bear market condition, which results in large negative movements (Davies, 2013).

In Table 4.10 panel one, the coefficients of inflation growth rate (α_0), money supply growth rate (α_1), industrial production growth rate (α_4) and growth rate of REER (α_5), were positive; growth rate of REER was statistically significant at a 5 percent level of significance. Thus, a 1 percent increase or decrease in the growth rate of REAR will cause the Telecommunication Index returns to increase by 0.333 percent in a bull market condition, *ceteris paribus*. In addition, the coefficients attributed to short-term interest growth rate (α_2) and long-term interest growth rate (α_3) were negative; long-term interest growth rate was significant at a 5 percent level of significance. Thus, long-term interest growth rate had a significant negative affect on the Telecommunication Index returns in a bull market condition.

In Table 4.10 panel two, only long-term interest growth rate (α_3) was statically significant at a 10 percent level of significance. Thus, the Telecommunication Index returns was affected significantly negatively by long-term interest growth rate in a bear market condition, which will cause the Telecommunication Index returns to decrease by 2.104 percent, *ceteris paribus*. Furthermore, the coefficients of inflation growth rate (α_0), short-term interest growth rate (α_2) and industrial production growth rate (α_4) were positive, whereas the coefficients money supply growth rate (α_1), long-term interest growth rate (α_3) and growth rate of REER (α_{05}) were negative.

It was seen that the coefficients of money supply growth rate and growth rate of REER (short-term interest growth rate) were positive (negative) in a bull regime and negative (positive) in a bear regime. Also, growth rate of REER was found to be significant in a bullish market condition and not in a bearish market condition. Thus, AMH was confirmed by these results as macroeconomic variables influenced JSE Telecommunication Index returns differently under changing market conditions. When objective one and two were answered, Telecommunication Index returns was significantly positively affected by growth rate of REER in a bull market condition and significantly negatively affected by long-term interest growth rate in a bull and bear market conditions.

Residual Diagnostic Test: Jarque-Bera Normality Test

In Table 4.10, panel 3, the Jarque-Bera normality test is presented together with the Jarque-Bera statistic and the p-value. It was evident that the p-value associated with the Jarque-Bera statistic was 0.00. This allowed for the rejection of the null hypothesis: residuals were normally distributed, in favour of the alternative hypothesis: residuals were not normally distributed, at a 1 percent level of significance. The study confirmed departure from normality in the residuals of the estimated Equation 10.

4.51.6. The Financials Index Regime-Switching Results

Table 4.11: FIN_IND Markov Regime-Switching model of Conditional Mean

$\boldsymbol{FIN\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta LT\_INT + \alpha_{4ict}\Delta INU\_PRO + \alpha_{5ict}\Delta REER + \varepsilon_{c_t,}}$			
Financials Index			
Regime 1: Bull Market Condition			
Independent Variable	**Coefficient**	**z-Statistic**	**Prob.**
μ	0.822*	1.787	0.074
α_0	0.416	0.601	0.548
α_1	0.276	1.358	0.174
α_2	-0.029	-0.310	0.756
α_3	-0.436***	-4.088	0.000
α_4	-0.014	-0.037	0.970
α_5	0.135	1.270	0.204
σ^2	1.176***	19.378	0.000
Regime 2: Bear Market Condition			
μ	-1.700	-0.884	0.377
α_0	0.650	0.383	0.702
α_1	-0.267	-0.407	0.684
α_2	-0.320*	-1.701	0.089
α_3	-0.665**	-2.214	0.027

$\boldsymbol{\alpha_4}$	1.042	0.768	0.443
$\boldsymbol{\alpha_5}$	-0.015	-0.055	0.956
$\boldsymbol{\sigma^2}$	2.093***	24.692	0.000
Residual Diagnostic Test			
Normality Test			
Jarque-Bera	1557.044***	-	0.00

Note: *, ** and * indicate a 1%, 5% and 10% level of significance respectively. All figures are rounded off to 3 decimal places.*

Bull and Bear Market Condition in the Financials Index

It was noticeable from Table 4.11 panel one and two that when the Financials Index was in a bull market condition, the returns (0.822 percent) attained was positive, statically significant at a 10 percent level of significance and higher than that of the returns (-1.007 percent) in a bear market condition. This was expected as in a bull (bear) market condition, the returns of a stock index were increasing (decreasing) over time (Dhlamini, 2017). The Financials Index returns was more unstable in the bear market condition as opposed to the bull market condition. As the error variance (σ^2) of the bear market condition (1.176 percent and statically significant at a 1 percent level of significance) is higher than that of the bull market condition (2.093 percent and statically significant at a 1 percent level of significance). These findings suggested that the Financials Index returns was positive and less volatile when the returns were increasing (bull market condition). Thus, there existed more positive returns for the Financials Index returns.

In Table 4.11 panel one, the coefficients associated with inflation growth rate (α_0), money supply growth rate (α_1) and growth rate of REER (α_5) in a bull market condition were positive. However, short-term interest growth rate (α_2), long-term interest growth rate (α_3) and industrial production growth rate (α_4) coefficients were negative and only long-term interest growth rate was statically significant at a 1 percent level of significance. Thus, the Financials Index returns was significantly negatively affected by fluctuations in long-term interest growth rate in a bull market condition.

In Table 4.11 panel two, the coefficients of inflation growth rate (α_0) and industrial production growth rate (α_4) were positive, whereas the coefficients for money supply growth rate (α_1), short-term interest growth rate (α_2), long-term interest growth rate (α_3) and growth rate of REER) (α_5), were negative, long-term interest growth rate and short-term interest growth rate were significant at a 10 percent and 5 percent level of significance respectively. Thus, a 1 percent increase or decrease in short-term interest growth rate or long-term interest growth rate will cause the Financials Index returns to decrease by 0.320 percent and 0.665 percent respectively in a bear market condition, *ceteris paribus*.

When a comparison was conducted between the bull and bear market conditions, it was seen that where the coefficients were positive (negative) for money supply growth rate and growth rate of REER (industrial production growth rate) in a bull market condition, they were negative (positive) in the bear market condition. Moreover, short-term interest growth rate was found to be significant in a bear regime but insignificant in a bull regime. This showed that the effect of macroeconomic variables on the Financials Index returns were regime dependent. Hence, the affect did alternate as different market conditions were experienced as supported by AMH (Lo, 2004). Thus, Financials Index returns were significantly negatively affected by long-term interest growth rate in a bull and bear market conditions and significantly negatively affected by short-term interest rate in a bear market condition.

Residual Diagnostic Test: Jarque-Bera Normality Test

In Table 4.11, panel 3, the Jarque-Bera normality test is presented together with the Jarque-Bera statistic and the p-value. It was evident that the p-value associated with the Jarque-Bera statistic was 0.00. This allowed for the rejection of the null hypothesis: residuals were normally distributed, in favour of the alternative hypothesis: residuals were not normally distributed at a 1 percent level of significance. The study confirmed departure from normality in the residuals of the estimated Equation 11.

4.5.1.7. The Technologies Index Regime-Switching Results

Table 4.12: TECH_IND Markov Regime-Switching model of Conditional Mean

$$\boldsymbol{TECH\_IND = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta LT\_INT + \alpha_{4ict}\Delta INU\_PRO + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}}}$$

Technologies Index			
Regime 1: Bull Market Condition			
Independent Variable	**Coefficient**	**z-Statistic**	**Prob.**
$\boldsymbol{\mu}$	2.363**	2.099	0.036
$\boldsymbol{\alpha_0}$	-0.111	-0.068	0.946
$\boldsymbol{\alpha_1}$	-0.054	-0.132	0.895
$\boldsymbol{\alpha_2}$	-0.196	-0.993	0.321
$\boldsymbol{\alpha_3}$	-0.201	-0.874	0.382
$\boldsymbol{\alpha_4}$	-0.646	-1.078	0.281
$\boldsymbol{\alpha_5}$	0.398*	1.701	0.089
$\boldsymbol{\sigma^2}$	1.547***	16.184	0.000

Regime 2: Bear Market Condition			
μ	-0.391	-0.154	0.877
α_0	-1.567	-0.666	0.505
α_1	-0.170	-0.194	0.846
α_2	-0.069	-0.241	0.809
α_3	-0.254	-0.568	0.570
α_4	0.386	0.207	0.836
α_5	-0.391	-0.716	0.474
σ^2	-1.567***	35.607	0.000
Residual Diagnostic Test			
Normality Test			
Jarque-Bera	203.798***	-	0.00

Note: *, ** and * indicate a 1%, 5% and 10% level of significance respectively. All figures are rounded off to 3 decimal places.*

Bull and Bear Market Condition in the Technologies Index

In Table 4.12 panel one and two, the returns (μ) of the Technologies Index in a bull market condition was 2.363 percent, whereas in a bear market condition it was -0.391 percent. The bull market condition returns were statistically significant at 5 percent level of significance. The returns of the Technologies Index were more volatile in the bear market condition as opposed to the bull market condition as indicated by the error variance (σ^2). It suggested that investors who are risk-averse and incorporated companies in their portfolio that formed part of the Technologies Index, earned a high return on their investments in an upper market condition as opposed to the lower market condition. When the returns increased it remained positive and less volatile in a bull market condition as opposed to the negative and unstable values in a bear market condition.

In Table 4.12, panel one and two, the coefficients of growth rate of REER (α_5) were positive and statically significant at a 10 percent level of significance in a bull market condition. The coefficients associated with inflation growth rate (α_0), money supply growth rate (α_1), short-term interest growth rate (α_2), long-term interest growth rate (α_3) and industrial production growth rate (α_4) were negative. The positive and significant coefficient attained to Industrial production growth rate suggested that it affected the Technologies Index returns positively in a bull market condition. In the bear market condition, the coefficient of industrial production growth rate was insignificant and negative. This alternating efficiency and positive and negative effect on the Technologies Index returns was attributed to AMH. According to AMH, the effect of macroeconomic variables varied when market conditions were imposed, therefore, EMH did not hold when the stock market index experienced changing market conditions (Lo, 2004). This was seen herein with all JSE indices and not only the Technologies Index. Thus, the Technologies Index returns was significantly positively affected by industrial production growth rate in a bull market condition.

Residual Diagnostic Test: Jarque-Bera Normality Test

In Table 4.12, panel 3, the Jarque-Bera normality test was presented together with the Jarque-Bera statistic and the p-value. It was evident that the p-value associated with the Jarque-Bera statistic was 0.00. This allowed for the rejection of the null hypothesis: residuals were normally distributed, in favour of the alternative hypothesis: residuals were not normally distributed, at a 1 percent level of significance. The study confirmed departure from normality in the residuals of the estimated Equation 12.

4.5.2. Transition Probabilities and Constant Expected Duration Results

The transition probabilities and constant expected duration were estimated to compare the levels of bull and bear market conditions across the JSE indices. Thus, objective three of the study was answered in this section. Table 4.13 gives the transition probabilities and the constant expected duration associated with each JSE index. The study first conducted an individual discussion of the transition probabilities and the constant expected duration for each JSE index; thereafter, a comparative analysis is done.

Table 4.13: JSE Indices Transition Probabilities and Constant Expected Duration

$$\boldsymbol{Prob} = \begin{vmatrix} \boldsymbol{Prob(C_t = 1/C_{t-1} = 1)} & \boldsymbol{Prob(C_t = 2/C_{t-1} = 1)} \\ \boldsymbol{Prob(C_t = 2/C_{t-1} = 2)} & \boldsymbol{Prob(C_t = 1/C_{t-1} = 2)} \end{vmatrix} = \begin{vmatrix} \boldsymbol{Prob_{11}} & \boldsymbol{Prob_{21}} \\ \boldsymbol{Prob_{22}} & \boldsymbol{Prob_{12}} \end{vmatrix}$$

	JSE_ALSI	**INU_IND**	**CONG_IND**	**CONS_IND**	**TELCOM_IND**	**FIN_IND**	**TECH_IND**
Regime 1: Bull Market Condition							
Transition Probabilities and Expected Duration Probabilities							
P_{11}	0.988	0.968	0.637	0.962	0.980	0.987	0.965
T_{11}	81.373	30.805	2.757	26.479	49.268	76.748	28.322
Regime 2: Bear Market Condition							
Transition Probabilities and Expected Duration Probabilities							
P_{22}	0.972	0.830	0.764	0.986	0.856	0.967	0.965
T_{22}	36.123	5.871	4.236	73.858	6.952	30.744	28.796

**Note P_{11} and P_{22} is the transition properties of a bull and bear regime respectively, whereas T_{11} and T_{22} is the constant expected duration of a bullish and bearish regime. All figures are rounded off to 3 decimal places.*

4.5.2.1. The JSE All-Share Index

The first and second panel of Table 4.13 represents the regime probabilities and the constant expected duration associated with the JSE All-Share Index returns. The transition probabilities of the index returns for a bull market condition (P_{11}) and a bear market condition (P_{22}) were persistent as the transition properties were between 0.988 and 0.972, which was closer to 1. Thus, the probability of the index returns being in an upper market condition (0.988) was higher than the probability of being in a lower market condition (0.972). This suggested that the index returns spent more time in a bull regime as opposed to the bear regime. This was consistent with the constant expected duration as the index returns spent approximately 81 months in a bullish market condition (T_{11}) and 36 months in a bearish market condition (T_{22}).

4.5.2.2. The Industrial Metal and Mining Index

The transition probabilities depicted for the Industrial Metal and Mining Index returns following a bull market condition and bear market condition were 0.968 and 0.830 respectively. This suggested the probability of being in bull market condition and remaining in that bull market condition in the following month was 0.968 percent, while that of staying in bear market condition and remaining in a bear market condition in the following month was 0.83 percent. Thus, the bullish and bearish market conditions were highly persistent as it indicated that when index returns entered a bull market condition or bear market condition it tended to remain in the respective regimes. Moreover, the index returns seemed to have more bull market conditions followed by the bull market conditions than bear market conditions followed by bear market conditions. Hence, the index returns was expected to remain for 30 months in an upper market condition and 5 months in a lower market condition

4.5.2.3. The Consumable Goods Index

The transition probabilities associated with Consumable Goods Index returns in the bull market condition was 0.637 percent and in the bear market condition it was 0.764 percent. Thus, the probability of the index returns being in a bullish market condition (0.637) was lower than the probability of being in a bearish market condition (0.764). Hence, index returns spent more time in a bear market condition than a bull market condition. This indicated that the index returns stayed for shorter periods in bear market condition as the transition properties were between 0.764 and 0.637, which was further away from 1. Hence, the transition probabilities of moving from a bull regime to a bear regime were less persistent as index returns tended to react immediately to fluctuations in the macroeconomic variables in bull and bear markets conditions. This phenomenon was supported by the low constant expected duration as the index returns stayed longer in a bear regime (4 months) as opposed to the bull regime (3 months).

4.5.2.4. The Consumable Service Index

For the Consumable Service Index returns, the transition probabilities were highly persistent at between 0.962 and 0.986, which was closer to one. Thus, the probability of the index returns being in a bullish market condition (0.962) was lower than the probability of being in a bearish market condition (0.986). This suggested that the index returns spent more time in a bear regime as opposed to the bull regime. This was consistent with the constant expected duration as the index returns spent approximately 26 months in a bull market condition and 73 months in a bear market condition.

4.5.2.5. The Telecommunication Index

In Table 4.13, the transition probabilities of the Telecommunication Index returns following a bull market condition (0.980 percent) was higher than that of the bear market condition (0.856 percent). The transition probabilities were highly persistent, which indicated that once the index returns entered a bull market condition or bear market condition it tended to remain in the respective regime. Thus, the index returns spent more time in a bull regime than a bear regime. The constant expected duration confirmed these findings, as the index returns stayed in a bull market regime for 50 months and in a bear regime for seven months.

4.5.2.6. The Financials Index

The transition probabilities for the Financials Index returns in a bull market condition was 0.987 percent and in a bear market condition it was 0.967 percent. Thus, the index returns remained longer in a bull market condition than a bear market condition. The transition probabilities were between 0.987 and 0.967, which was close to one. Thus, once the index returns entered a bull market condition or bear market condition it tended to remain in the respective regimes. The transition probabilities for index returns were supported by the constant expected duration as the index returns stayed for 76 months in a bull regime and 30 months in a bear regime.

4.5.2.7. The Technologies Index

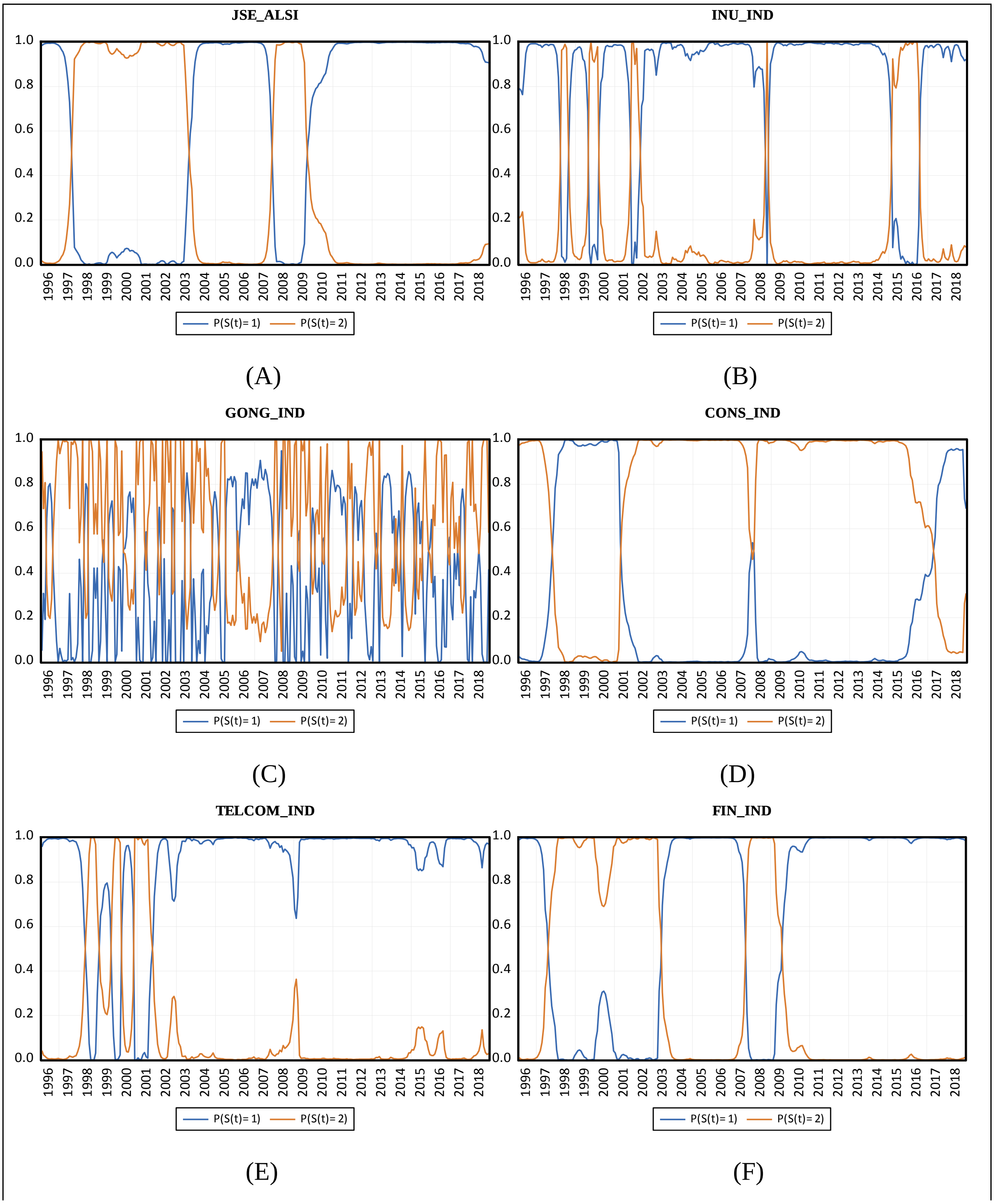
In Table 4.13, it is evident that the transition probabilities associated with the bull and bear market conditions were the same (0.965). This suggested that Technologies Index returns remained in the bull and bear market conditions for the same amount of time. This phenomenon was supported by the constant expected duration, as the index returns stayed in an upper and lower market conditions for 28 months.

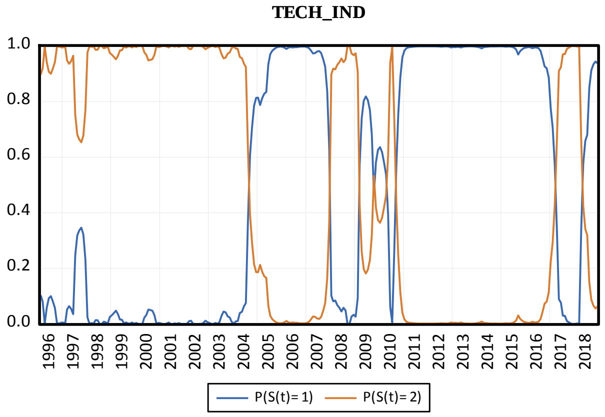
4.5.2.8. Comparison of Findings of Expected Duration in Bull and Bear Market Conditions

Objective three of the study entailed comparing the levels of bull and bear market conditions across the JSE sectors. Having discussed the findings of each JSE index individually, the study conducted a comparison. The first clear sign presented herein is that the JSE All-Share Index returns stayed the longest in a bull market condition (81 months) when compared to other JSE indices. This was followed by the Financials Index returns (76 months), Telecommunication Index returns (49 months), Industrial Metal and Mining Index returns (30 months), Technologies Index returns (28 months), Consumable Service Index returns (26 months) and the Consumable Goods Index returns (2 months). Contrastingly, the study found the Consumable Service Index returns remained the longest in the bear market condition (73 months). This was followed by the JSE All-Share Index returns (36 months), Financials Index returns (30 months), Telecommunication Index returns (6 months), Industrial Metal and Mining Index returns (5 months) and Consumable Goods Index returns (4 months). The findings of the JSE All-Share Index returns in a bull regime and the Consumable Service Index returns in a bear regime were in line with their transition probabilities as both regimes moved from a bull market condition to bear market condition and bear market condition to bull market condition faster than other JSE indices returns. Moreover, the study found that of the two market conditions (bull and bear conditions), the bull market condition was more persistent among the JSE sectors as the JSE All-Share Index returns, Industrial Metal and Mining Index returns, Telecommunication Index returns and Financials Index returns remained the longest in a bull regime as opposed to a bear regime.

4.5.3. Smooth Regime Probabilities Results

This section focuses on the interpretation of smooth regime probabilities graphs because it enables the identification of the changes in the stock indices returns with references to the prevailing market condition. Hence, the graphical representation of the smooth regime probabilities of each JSE index and the interpretation follows:


JSE_ALSI
INU_IND
GONG_IND
CONS_IND
TELCOM_IND
FIN_IND
P(S(t)= 1)
P(S(t)= 2)
(A)
(B)
(C)
(D)
(E)
(F)



(G)

Figure 4.2: Smooth Regime Probabilities of the Stock Market Indices
Data Source: Own Compilation

4.5.3.1. The JSE All-Share Index

In Figure 4.2 (A), the smooth regime probabilities graph associated with the JSE All-Share Index returns indicated that once the index returns entered a bullish or bearish regime it tended to stay in the respective regime for a long period of time. This was evident as the index returns remained in bull regime from 1996 to 1997, 2003 to 2007, 2010 to 2018 and in a bear regime between 1997 to 2003 and 2007 to 2009. This finding was supported by the high transition probabilities and the constant expected duration of the index returns given in Section 4.5.2.1. The time periods that the index returns remained in bear regime were in line with the contagion effect of the 1997 Asia financial crisis and the 2008/2009 global finical crisis, which saw a decrease in global stock market returns due to negative affect associated with the events. It was said once a stock market returns entered a bearish market condition, categorised by falling returns, the stock market returns immediately (commencing the bearish period) entered into a bullish market condition, categorised by an increase in returns (Davies, 2013). Hence, after the bearish periods, the bullish periods took over.

4.5.3.2. The Industrial Metal and Mining Index

In Figure 4.2 (B), when the Industrial Metal and Mining Index returns entered a bull market condition, it immediately fell back into a bear market condition throughout 1996 to 2002. Hence, during the period of 1996 to 2002, the index returns did not stay in the market conditions for prolonged periods of time. However, post-2002 was when the transition probabilities were persistent as the index returns remained in the respective regimes for a considerable amount of time. Thus, the index returns remained in a bull market condition between 2002 to 2007, 2009 to 2014, 2017 to 2018 and a bear market condition between 2008 to 2009 and 2015 to 2016. The decrease in the index returns (bearish market condition) was clearly attributable to the 2008/2009 global financial crisis. However, the decrease in the index returns between 2015 and 2016 was attributed to the US-dollar commodity price, which was offset by the weaker rand (PWC, 2016). Companies incurred increase costs, which eroded revenue margins and inevitably affected the returns of each company and the overall index returns.

4.5.3.3. The Consumable Goods Index

In Figure 4.2 (C), it was seen that the bull regime spiked suddenly and immediately fell back into a bear regime. This suggested that the Consumable Goods Index returns did not remain in a bull or bear regime for prolonged periods of time. This was confirmed by the transition probability of the index returns in Section 4.5.2.3, which indicated less persistence of each market period. The constant spike of the bull market then spike in a bear market condition was experienced throughout the sample period, with exception to the period between 2005 and2007. The bullish market condition prevailed between 2005 and 2007 as the 2008/2009 down-turn in the global equity market caused by the financial crisis was evident in the subsequent period. Hence, a bearish period was followed by a bullish period and vice versa (Davies, 2013).

4.5.3.4. The Consumable Service Index

In Figure 4.2 (D), the smooth regime probabilities graph indicated that the Consumable Service Index returns did not alternate from a bearish to bullish market conditions frequently as there were no spikes in the graphical representation. Thus, the probability of the index returns transitioning from bull regime to a bear regime was very persistent, as the index returns stayed in the various market conditions for prolonged periods of time. This was supported by the high transition probabilities associated with the index returns in Section 4.5.2.4. It was noted that the bullish market condition was evident in the index returns from 1998 to 2001 and 2017 to 2018 and the bearish market condition from 1996 to 1997 and 2002 to 2016. Hence, the index returns stayed longer in a bear regime as supported by the constant expected duration in Section 4.5.2.4. The bearish period from 2002 to 2016 was associated with the pre- and post-2008/2009 global financial crisis. Company shares that formed part of the Consumable Service Index returns decreased due to investors selling their share in the companies and withdrawing from the equity market in anticipation of negative returns cause by the financial event (Majapa and Gossel, 2016). The market remained in a negative growth phase post-financial crisis as investors were sceptical to invest in companies that formed part of the index due to various companies closing operations.

4.5.3.5. The Telecommunication Index

In Figure 4.2 (E), when the Telecommunication Index returns entered a bull market condition, it immediately fell back into a bear market condition between 1998 and 2001. This suggested that the index returns did not stay in the market conditions for prolonged periods of time. Furthermore, post-2001, the index returns entered a bullish regime and stayed in the market condition for the complete duration of the sample period. However, during 2008 and 2009 there existed a spike in the bearish market, which suggested that the index returns experienced a period of decreasing returns. Thus, this phenomenon was evident across all JSE industry-based indices and global stock market returns, therefore, not surprising. The phenomenon was a direct result of the 2008/2009 global financial crisis, which caused a negative impact on global stock market returns (Boako and Alagidede, 2018).

4.5.3.6. The Financials Index

In Figure 4.2 (F), it was seen that the Financials Index returns transitioning from a bull market condition to a bear market condition were fairly low. Thus, the index returns stayed in each market condition for long periods of time. This was in line with the transition probabilities associated with the index returns in Section 4.5.2.6. It was further noted that the bullish market condition prevailed across index returns between periods 2004 to 2007 and 2010 to 2018. The contagion effect of the US housing bubble in the early 2000s, coupled with the 2008/2009 global finical crisis, negatively affected the SA financial sector. The financial firms experienced drastic losses due to failed portfolio management caused by the decrease in global stock market returns (Gordhan, 2012). Thus, the stock returns of various financial firms decreased due to panic arising among investors, which attempted to replenish returns on investments (Hull, Danso and Adomako, 2014). It was evident that during 1997 and 2008, the Index returns were in a bearish market condition.

4.5.3.7. The Technologies Index

In Figure 4.2 (G), as with many of the JSE industry-based indices, the Technologies Index returns remained in a bull and bear periods for long periods of time; during 1996 to 2004, the index returns were in a bear period. Thus, the index returns were categorised as decreasing, as represented by the market condition. The observation was attributed to the negative contagion effect faced by global technology companies owing to the formation of the US dot-com bubble in the 1990s and the burst of the bubble in the mid-2000s (Crain, 2014). The global technologies advancements and the increased returns experienced by US technology companies caused investors around the world to invest in local technology companies (Alagidede, 2008). However, when the bubble burst, the contagion affect was evident across the world as the returns of these companies fell and in turn caused the formation of bear market conditions as evident in the Technologies Index returns (Duncan and Kabundi, 2011). However, stock market returns recovered after 2004 and thus, the index returns entered a bullish market condition. Thereafter, the contagion effect of the 2008/2009 global financial crisis saw the index returns enter into a bearish market condition again, but not for long as the index returns recovered post-2009 and remained in a bull market condition until the end of the sample period.

4.6. Discussion of the Findings

Having presented the individual findings of the study, the comparison of findings was necessary. It was essential that the study elaborated on the implications the results had on theoretical expectations. According to Lo (2004), it takes a theory to beat a theory. Hence, the findings of any study need to coincide with theoretical justifications as it provided in-depth meaning. This section analyses the findings in line with the objectives of the study and provides detailed explanations surrounding the implications regarding financial theories and empirical findings.

Table 4.14: Summary of Findings

Conditions		**JSE_ALSI**	**INU_IND**	**CONG_IND**	**CONS_IND**	**TELCOM_IND**	**FIN_IND**	**TECHIND**
Bull		81 Months	30 Months	2 Months	26 Months	49 Months	76 Months	28 Months
Bear		36 Months	5 Months	4 Months	73 Months	6 Months	30 Months	28 Months
Remark		*Bull*	*Bull*	*Bear*	*Bear*	*Bull*	*Bull*	*Bull and Bear*
Effect of Macroeconomic Variables								
CPI	**Bull**	No	No	No	No	No	No	No
	Bear	No	Yes	Yes	No	No	No	No

M2	**Bull**	No	No	No	No	No	No	No
	Bear	No	No	No	No	No	No	No
ST_INT	**Bull**	No	No	No	Yes	No	No	No
	Bear	Yes	No	Yes	No	No	Yes	No
LT_INT	**Bull**	Yes	No	No	No	Yes	Yes	No
	Bear	No	No	No	Yes	Yes	Yes	No
INU_PRO	**Bull**	No	No	No	No	No	No	No
	Bear	Yes	No	No	No	No	No	No
REER	**Bull**	No	No	Yes	No	Yes	No	Yes
	Bear	No	No	Yes	No	No	No	No

**Note: Yes, refers to significant at the 1%, 5% or 10% levels of significance and no means not significant at all.*

The summary of the findings presented in Table 4.14 provides an overview of the levels of bull and bear market conditions associated with the JSE indices returns, the market condition that prevailed among the JSE indices returns and the macroeconomic variables was found to have a significant effect on the JSE indices returns.

4.6.1. Finding on the Effect of Inflation (CPI) Growth Rate on Stock Returns

The results of the Markov regime-switching model demonstrated that inflation growth rate significantly affected the Industrial Metal and Mining Index returns and the Consumable Goods Index returns in the bear market condition. However, it had no significant effect on the remaining industry-based indices. The findings were supported by previous studies that had examined JSE indices returns, these include Maysami et al. (2005), Jareno and Negrut (2016), Naicker (2017) and Banda (2019), which found JSE indices returns were positively or negatively affected by inflation. It was rather strange to find that inflation growth rate had no significant effect on the JSE All-Share Index returns, Consumable Service Index returns, Telecommunication Index returns, Financials Index returns and Technologies Index returns. However, this was consistent with the study of Paul and Mallik (2003) who found inflation to have an insignificant effect on sector prices in the Australian equity market.

The findings of inflation growth rate in the study were explained by the notion proposed by Tripathi and Kumar (2015). It was suggested that fluctuating inflation rates caused stock market prices to deviate from its actual value. This resulted in inflation eroding private sector revenue and purchasing power of disposable income. Market participants reacted by extracting equity investments to invest in consumption, which decreased the demand for marketable instruments, which caused households and corporate entities to save extensively. Furthermore, the high inflation rates induced monetary policy authorities to increase interest rates to tighten the eroding effect of disposal income and private sector revenue. Moreover, the increase in domestic interest rates caused an increase in the discount rate used to evaluate shares, therefore, had a significant effect on equity returns. Thus, it was seen that inflation growth rate only had a significant effect on selected JSE index returns in a bear market condition. However, the effected varied such that a significant positive effect was evident as well as a significant negative effect in a bear market condition.

4.6.2. Finding on the Effect of Money Supply (M2) Growth Rate on Stock Returns

The findings showed money supply growth rate had no significant effect on the JSE industry-based indices returns under bull and bear market conditions. This was contrary to studies conducted by Maysami et al. (2005), Mohammad et al. (2017), Ndlovu et al. (2018) and Molele (2019), which found money supply affected stock market returns. The effect money supply had on stock market prices was said to be an empirical one. Thus, an increase in the money supply caused the inflation rate and the discount rate to increase. When this occurred, investors incurred more significant opportunity costs, which caused a substitution effect away from marketable securities, resulting in a decrease in stock prices and a decrease in the demand for marketable securities. However, money supply also tended to attribute positive outcomes relating to economic stimulus, whereby it increased stock prices and cashflows of corporates (Maysami and Koh, 2000). Thus, the overall effect of money supply on stock market prices depended on the extent to which it caused the discount rate and cash flows to vary from its actual value. Hence, it could either be a significant or insignificant effect on stock market returns.

4.6.3. Finding on the Effect of Short-Term and Long-Term Interest Growth Rates on Stock Returns

The findings of the study showed that short-term interest growth rate had a significant effect on the Consumable Service Index returns in a bullish market condition and significant effected the JSE All-Share Index returns, Consumable Goods Index returns and Financials Index returns in a bearish market condition. Furthermore, long-term interest growth rate had a significant positive affect on the Telecommunication Index returns and the Financials Index returns in an upper and lower market conditions and a significant effect on the JSE All-Share Index returns in an upper market condition and the Consumable Service Index returns in a lower market condition. The findings were consistent with the empirical literature, which found interest rates to have a significant effect on JSE indices returns (Jefferis and Okeahalam, 2000, Alam, 2013, Eita, 2012 and Naicker, 2017). However, having found interest growth rate to have no significant effect on other industry-based indices is not surprising in nature, despite Modigliani and Cohn (1979) who found interest rates to be a significant driving force of stock market returns. When analysing the more recent literature, it was not always assured that fluctuating interest rates had a significant effect on stock market returns under changing market conditions. However, the study noted that the effect short-term and long-term interest growth rates had on selected JSE index returns were evident in bull and bear market conditions. Thus, the effect was seen when stock market returns were increasing or decreasing over time.

The findings of the study can be explained by interest rate theory. An increase (decrease) in short-term interest rates resulted in a higher (lower) discount rate. When the discount rate was said to increase, it prompted a higher opportunity cost for holding money, which resulted in market participants substituting equity-bearing securities for interest-bearing securities (Ray, 2012). This inevitably decreased the demand for equity securities. Furthermore, fluctuations in government bond yields were said to have the same effect on the discount rate; that being, when the interest rate increased, it caused the nominal risk-free rate to increase. As a result, the financial cost of corporates elevated (Mukherjee and Naka, 1995). Therefore, a significant effect on stock market returns was evident.

On the other hand, finding no significant effect suggested that the companies that formed part of the industry-based indices were shielded from fluctuations in interest rates, such that constituents debt funding was less effected by fluctuating interest rates or the industry-based sectors contained high ability to hedge against flatulating interest rates. The reason as to why Industrial Metal and Mining Index returns and the Technologies Index returns were not significantly affected by short-term and long-term interest rates under changing market conditions can be investigated by future studies.

4.6.4. Finding on the Effect of Industrial Production Growth Rate on Stock Returns

The findings showed that industrial production growth rate had a significant effect on the JSE All-Share Index returns in a bear market condition. Thus, industrial production growth rate only had a significant effect on JSE index returns in a bear market condition. Thus, when stock market returns were increasing the effect was noticeable. This was consistent with studies conducted by Sohail and Hussain (2009), Jareno and Negrut (2016) and Habib and Islam (2017), which showed that the industrial production growth rate did effect JSE index returns and equity returns in general. The findings were attributed to the fact that industrial production growth rates contain high sensitivities to interest rates, whereby the lowering of interest rates by monetary authorities caused an increase in industrial production, which increased stock prices (Chen et al., 1986). Share prices were said to increase as the decreasing interest rate enticed investors to switch from interest-bearing securities to marketable securities to take advantage of the lower interest rates. This increased the demand for marketable securities, which inevitably increased stock market prices. Hence, there existed such findings in the study.

4.6.5. Finding on the Effect of Growth Rate of Real Effective Exchange Rate on Stock Returns

The Consumable Goods Index returns were significantly affected by growth rate of REER in a bullish and bearish regime, whereas the Telecommunication Index returns were affected significantly by growth rate in REER in a bullish regime and the Technologies Index returns in a bearish regime. Thus, the effect was evident under bull and bear market conditions. This was consistent with studies by Sohail and Hussain (2009), Zhao, (2010) and Hsing (2013a), which found REER to affect stock market returns.

It was noted in the SA context that when the SA rand appreciated it caused an increase in the price of SA exported products to international countries. Thus, the increased price of exported products caused a decrease in the demand for the SA exported product, which decreased the cashflow generated from the net proceeds. Moreover, if the rand was depreciating, SA exported products were cheaper for international countries that imported local products, which lead to high demand for the products and inevitably increased cashflows (Horobet and Ilie, 2007). Many of constituents that form part of the industry-based indices manufactured products that were exported, therefore, paid in the currency of international trading partners, which was used in the calculation of the REER. Hence, if the rand appreciated (depreciated) relative to these currencies, there was a decrease (increase) in the rand profits. Thus, there existed a significant effect between REER and stock market returns.

It was noted that the constituents that formed part of the industry-based indices contained primary listings in international equity markets. Hence, it was important to understand the affect it had on the JSE index returns where constituents had secondary listings. The study considered the British American Tabacco PLC that formed part of the Consumable Goods Index. The company also contained a secondary listing on the London Stock exchange; thus, the JSE share price was directly driven by the secondary listing. The UK REER had a direct effect on the share prices of British American Tobacco PLC, such that the share price improved in relation to the rand deprecating against the pound. Hence, affecting the net cash flow from exports. Thus, the overall industry-based index was directly influenced by the secondary listing of its constituents.

4.6.6. Theoretical Explanation of Findings

It was seen that macroeconomic variables had an alternating effect on each JSE index returns; where macroeconomic variable had a significant effect on JSE index returns in a bear regime, the effect was insignificant in a bull regime and vice versa. Thus, the alternating efficiency and inefficiency were present amongst the JSE index returns. Similar findings were found in studies by Bonga-Bonga and Makakabule (2010) and Abadi and Ismail (2016). The explanation was attributed to the notion that the affect macroeconomic variables had on stock market returns was regime dependent; the alternating efficiency affect varied according to regimes (Bong-Bonga and Makakabule, 2010). It varied as the performance of stock market returns under each regime was known, that being, in an upper market condition the stock market returns were increasing, whereas in a lower market condition the stock market returns were decreasing (Davies, 2013). Hence, stock market returns did not follow a random walk process as the future returns of the index was known to investors.

The findings of the study were consistent with the AMH, as it suggested that the efficiency and inefficiency of equity markets were owing to changing market conditions (Lo, 2004). Thus, macroeconomic factors affected stock market returns differently under changing market conditions. Moreover, the findings were seen to contradict the EMH, as the hypothesis suggested that stock market future closing prices/returns were not known by market participants, therefore, followed the random walk process, making equity markets efficient (Fama, 1965. This meant excess returns could not be earned as stock prices incorporate all available information and as such there exist a linear relationship between macroeconomic variables and stock market returns (Huang, 2019). AMH refuted this, as the financial theory suggested that macroeconomic variables did effect stock market returns and were time varying (nonlinear) (Kumar, 2018). Furthermore, under bull and bear market conditions, future stock market prices/returns were known to investors as in a bull market condition the stock index returns were increasing and in a bear market condition, stock prices were decreasing (Davies, 2013). Thus, the alternating efficiency effect under changing market conditions existed, which was found in the study.

4.6.7. Finding on the Bull and Bear Market Condition across the JSE Industries

It was evident that the bullish market condition prevailed among the relevant JSE indices returns, namely, JSE All-Share Index returns, Industrial Metal and Mining Index returns, Telecommunication Index returns and the Financials Index returns. This suggested that the returns were positive and increasing over time for the relevant JSE indices. Thus, such increasing and positive returns were favourable to investor as higher returns were earned on their investments. Hence, it not only attracted investors' participation but also increased the contribution to the financial sector and in turn the SA economy. The finding was not surprising as studies by Guidolin (2016) and Maheu et al. (2012) found a higher presence of a bull market condition among stock market returns. It was explained that when stock index returns entered an upper market condition the returns were increasing over a period, which attracted investment, as favourable conditions enticed market participation (Davies, 2013). The excessive market participation allowed for the bull market condition to remain longer as higher rate of share purchases formed part of the stock market index (Guidolin, 2016). Contrastingly, when the stock market index returns entered a bear regime, the share returns were falling over a period (Davies, 2013). This eliminated participation and demand for shares that formed part of the index; therefore, the market condition did not prevail, as limited participation was evident (Maheu et al., 2012).

4.7. Chapter Summary

The study used the Markov regime-switching model of conditional mean with constant transition probabilities. The graphical representation of the JSE index returns and macroeconomic variables depicted that both series were stationery with no trend. The correlation analysis provided the existence of an association between macroeconomic factors and JSE indices returns. The study confirmed the findings of the graphical representations as the ADF, PP and KPSS unit root and stationarity tests were implemented with an intercept. The findings confirmed stationarity in levels for the JSE indices returns and macroeconomic variables. Thereafter, the ADF-min-t break point test was implemented. The test confirmed the presence of stationary properties for both series in the presence of structural breaks.

The study then estimated the empirical model and the findings were: inflation growth rate significantly affected the Industrial Metal and Mining Index returns and Consumable Goods Index returns in the bear market condition. The money supply growth rate had no significant effect on the JSE indices returns. The short-term interest growth rate had a significant effect on Consumable Service Index returns in a bullish market condition and JSE All-Share Index returns, Consumable Goods Index returns and Financials Index returns in a bearish market condition. The long-term interest growth had a significant effect on the Telecommunication Index returns and Financials Index returns in upper and lower market conditions, whereas it had only a significant effect on the JSE All-Share Index returns in the upper market condition and Consumable Service Index returns in a lower market condition. The industrial production growth rate had only a significant effect on the JSE All-Share Index returns in a bear regime. The growth rate of REER significantly influenced the returns of the Consumable Goods Index returns in a bullish and bearish market conditions, whereas the Telecommunication Index returns and Technologies Index returns in a bull regime. Moreover, the bull regime was found to be relevant among the JSE indices returns, the JSE All-Share Index returns remained the longest in a bullish market condition and the Consumable Service Index returns remained the longest in a bearish market condition.

The next chapter provides the conclusion, summary, limitations and recommendations. There is a synthesis regarding the study, with more emphasis placed on the findings of the study, what limitations exists and what recommendations are made to enhance future research in this regard.

CHAPTER 5: SUMMARY, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

5.1. Introduction

The existing literature has shown that stock market returns are influenced by macroeconomic variables (Naicker, 2017; Khan et al., 2018; and Moelele, 2019). Contrary to earlier studies, the evolution of financial theories and recent studies demonstrated that the relationship between stock market returns and macroeconomic variables is not linear (Bong-Bonga and Makakabule, 2010; Panmanotham, 2016). This could imply that the effect macroeconomic variables have on stock market returns differs when the equity market condition varies from a bull market to a bear market and vice versa. As a result, it was important to determine how this effect varied on the JSE as such a study was not conducted in SA. Consequently, the study aimed at analysing the effect of macroeconomic variables on the returns of the JSE selected sectors in the presence of different market conditions. This chapter summarises and concludes the study.

Section 5.2 summaries the study and serves as a synthesis of the entire study, highlighting the essential aspects. Section 5.3 provides the overall conclusions based on the findings of the study. Sections 5.4 and 5.5 present the limitations and recommendations of the study.

5.2. Summary of the Study

At the onset of the research study, the academic proposed to examine the interaction between macroeconomic variables and stock index returns in SA, with emphasis placed on the effect macroeconomic variables have on the JSE indices returns under changing market conditions. The aim of the study was achieved through three specific research objectives. These objective focused on: (1) comparing how the overall JSE and its selected sectors responded to the changes in macroeconomic variables in a bullish market condition, (2) determining which macroeconomic variables affected the aggregated and disaggregated JSE returns under bearish condition and (3) determining the levels of bull and bear market conditions across the JSE sectors. In achieving these objectives, the study utilised the Markov regime-switching model of condition mean with constant transition probabilities. Moreover, preliminary tests in the form of graphical visualisations, descriptive statistics, correlation tests, unit root tests and stationarity tests, with and without structural breaks, were considered. Before the results from the statistical model were discussed, a normality test, which formed part of the diagnostic analyses of the residuals of the Markov regime-switching model, was estimated. The variables that formed part of the JSE consisted of the real values associated with the JSE All-Share Index, Industrial Metals and Mining Index, Consumer Goods 3000 Index, Consumer Services 5000 Index, Telecommunications 6000 Index, Financials 8000 Index and the Technologies 9000 Index. The macroeconomic variables included the real values of inflation (CPI) rate, industrial production rate, short-term interest rate, long-term interest rate, money supply (M2) and REER. JSE index returns series and the macroeconomic variables series contained monthly data covering the period 1996-2018.

In an attempt to provide a background surrounding macroeconomic variables and stock market returns, the literature provided a detailed analysis of the financial theories that related macroeconomic variables to equity market prices. Underlying financial theories (CAPM and APT) showed that the macroeconomic variables are considered to be among risk factors that influence stock market returns. Hence, macroeconomic variables either increase or decrease stock market returns, which is contagion upon the nature of the fluctuation of the macroeconomic variables from its real value. Moreover, the effect macroeconomic variables have on stock market returns are categorised as linear. EMH suggests that market participants are rational and stock returns reflect all available information, which limits the enhancement of access returns, making capital markets efficient. However, behavioural finance demonstrated that markets are not efficient as investors do not always act rationally due to ad hoc characteristics. The AMH reconciles EMH and behavioural finance. It shows equity markets have alternating periods of efficiency and inefficiency. AMH suggests the effect between macroeconomic variables and stock market returns is nonlinear as it changes with market conditions or regimes. As a result, changing market conditions result in alternating efficiency of stock market returns and the possibility that excess returns could be earned. Thus, it is evident that the debate surrounding the type of effect macroeconomic variables have on stock market returns still prevail. In an attempt to contribute to this debate in the previous empirical literature, the study was conducted.

The reviewed empirical literature included linear and nonlinear studies for both international and SA countries. The segregated literature resulted in a deductive comparison, whereby the effect of macroeconomic variables on international stock market returns was compared to that of SA stock market returns. The compared empirical literature depicts that the linear and nonlinear effects of macroeconomic variables on stock market returns are dependent on the performance of the economy, geographical region of the study and the nature of the methodology imposed. It is evident that the linear effect of macroeconomic variables on stock market returns alternate; that being, where macroeconomic variables positively influenced international stock market returns, it negatively influenced SA stock market returns and vice versa. The reason proposed by the academic studies was such that the economic performance of the country, stock market classification of indices and diverse methodologies imposed caused the varied effects under the linear empirical literature. The nonlinear empirical literature depicted a similar sight; however, there exists extensive international studies that reviewed the effect between macroeconomic variables and stock market returns as opposed to SA studies. It is noted that there is no study in the SA context that reviewed the effect of macroeconomic variables on the JSE index returns under bull and bear market conditions. The empirical nonlinear literature further expresses signs of a varying relationship between macroeconomic variables and stock market returns under changing market conditions, as proposed by AMH.

In determining the effect macroeconomic variables had on JSE indices returns, the study incorporated the Markov regime-switching model of conditional mean with constant transition probabilities. The empirical model utilised both formal and informal testing before the estimation of the model. It was found that both series were stationary with and without structural breaks. The Markov regime-switching model was regressed and the formulated hypotheses were answered as such:

H1: Macroeconomic variables had a significant effect on the JSE industry stock return in a bull market condition.

The effect of macroeconomic variables on the JSE index returns in a bullish market condition was found to vary across the JSE industries. It was evident that inflation growth rate, money supply growth rate and industrial production growth rate had no significant effect on the JSE indices returns in a bullish market. Furthermore, short-term interest growth rate had a significant negative effect on only the Consumable Service Index returns, whereas long-term interest growth rate significantly negatively affected the JSE All-Share Index returns, Telecommunication Index returns and Financials Index returns, in a bullish market. Given that short-term interest growth rate and long-term interest growth rate had a significant negative effect on selected JSE index returns. The growth rate of REER had a significant positive influence on the returns of the Consumable Goods Index returns, Telecommunication Index returns and the Technologies Index returns in a bullish market. Hence, some macroeconomic variables had a positive, negative or no significant effect on the JSE index returns in a bull market.

H2: Macroeconomic variables had a significant effect on the JSE industry stock return in a bear market condition.

In addition to the varying effect of macroeconomic variables on JSE index returns, the effect also alternated with the market condition; that being, where inflation growth rate and industrial production growth rate were found to have no effect on the JSE index returns in a bull market, they influenced the JSE index returns in a bear market. Inflation growth rate had a significant positive effect on the Industrial Metal and Mining Index returns and a significant negative effect on the Consumable Goods Index returns in the bear market condition. The industrial production growth rate had a significant positive effect on the JSE All-Share Index returns in a bear regime. Furthermore, where growth rate of REER significantly positively affected JSE index returns in a bull market, it significantly negatively affected index returns in a bear market; that being, growth rate of REER had a significant negative influence on the returns of the Consumable Goods Index returns in a bear market. It is seen that the effect macroeconomic variables have on stock market returns is regime-dependent, as proposed by AMH, which contains alternating efficiencies.

The effect of short-term interest rate growth rate and long-term interest growth rate is consistent under bull and bear market conditions. The effect was both significant negative under both conditions. However, additional JSE industries were affected by both variables in a bear market condition; that being, short-term interest growth rate had a significant negative effect on the JSE All-Share Index returns, Consumable Goods Index returns and Financials Index returns in a bearish market. The long-term interest growth rate had a significant negative effect on the Consumable Service Index returns, Telecommunication Index returns and the Financials Index returns in lower market conditions.

H3: The bull market condition remained the longest in the JSE industry-based indices.

The overall finding that was evident among the JSE index returns was one of an increasing returns (bull condition); that being, the bull market prevailed among the JSE All-Share Index returns (81 months), Industrial Metal and Mining Index returns (30 months), Telecommunication Index returns (49 months) and the Financials Index returns (76 months). Moreover, the time period that the Financials Index returns remained in a bull regime is closely related to the JSE All-Share Index. It suggests that the Financials Index returns tends to mimic the performance of the overall market; however, the bear market condition prevailed among the Consumable Goods Index returns (4 months) and the Consumable Service Index returns (73 months). The Technologies Index returns remained in a bullish and bearish market condition for the identical period (28 months). These JSE index returns tend to deviate from the general trend of the overall market: hence, they perform contrary to the overall market.

5.3. Conclusion

The study concluded that all macroeconomic variables, except money supply (M2), had either positive, negative or significant effects on the JSE indices returns under changing market conditions (e.g. growth rate of REER significantly positively affected JSE index returns in a bull market but significantly, negatively affected JSE index returns in a bear market. In addition, inflation growth rate had a significant positive and negative effect on JSE index returns under the same regime (bear regime)). Furthermore, where macroeconomic variables had a significant effect on the JSE index returns in a bear regime, the effect was insignificant in a bull regime and vice versa (e.g. Inflation growth rate and industrial production have no significant effect on JSE index returns in a bull market but had a significant effect on JSE index returns in a bear market). As a result, the alternating efficiency and inefficiency were present amongst the JSE index returns. This was consistent with AMH, as it suggests that the efficiency and inefficiency of equity markets are owing to changing market conditions. Hence, macroeconomic variables affect the stock market returns differently under changing market conditions. Moreover, the findings were seen to contradict EMH as it suggests equity markets are efficient. AMH refuted this, as the financial theory suggests that macroeconomic variables affect stock market returns and are time-varying (nonlinear). As a result, the alternating efficiency effect under changing market conditions exists in the study, suggesting that the effect of macroeconomic variables on stock market returns is explained by the AMH and could be better modelled by nonlinear models.

5.4. Limitations

Given that the study had achieved its objectives, there existed some limitations, which is commonly associated with studies of this kind. First, studies that analysed the effect macroeconomic variables had on stock market return under changing SA market conditions were limited; that being, there exists minimal domestic studies that were used to compare the findings of the study methodically. However, this did not affect the findings of the study, as international studies were used to conduct a comparison. Secondly, a wide variety of SA stock index returns and macroeconomic variables are presented under the empirical literature. However, the study incorporated a limited amount of these variables, as all macroeconomic variables and JSE indices could not be selected. It was noted that variables such as the JSE volatility index (VIX) and the SA unemployment rate, among others, were not included in the study due to data limitation; that being, data on the VIX and unemployment rate could not be obtained for the sample period of the study. However, the selected variables used in the study provided sufficient sample for the JSE and macroeconomic variables, which depicted necessary results to draw a meaningful conclusion.

5.5. Recommendations

The recommendations contained herein were based on the overall findings of the study. In Section 5.5.1, the study attempted to assist policymakers in making efficient alternations to macroeconomic variables. Furthermore, Section 5.5.2 entailed providing a proposition to market participants who held a portfolio that contained the companies that formed part of the study's JSE indices. Moreover, in Section 5.5.3, the study motivated the future enhancement of the studies on this topic.

5.5.1. Policy Makers

At the commencement of the study, it was evident that macroeconomic variables significantly influence JSE index returns, either positively or negatively. It is noted under the empirical literature that equity markets of developed and developing countries contribute to the enhancement of the economy through generated liquidity and wealth for market participants. Therefore, it is important for policymakers to control macroeconomic variables efficiently, as macroeconomic variables affect stock market returns differently under changing market conditions.

It was evident that the inflation growth rate and industrial production growth rate influence JSE selected index returns under a bear market. Therefore, the SARB must manage the inflation targeting regime and the industrial production growth rate, especially when the JSE is said to experience decreasing returns (bearish market). Furthermore, short-term interest growth rate, long-term interest rate growth rate and growth rate of the REER had the most significant influence on the selected index returns under changing market conditions. The SARB should consider that the effect of inflation, industrial production, short-term interest rate, long-term interest rate and REER on JSE index returns varies with regimes and, therefore, develop appropriate policies in line with such findings.

5.5.2. Market Participants

The findings show that the inflation growth rate, industrial production growth rate and growth rate of the REER had a significant positive effect on the selected index returns under changing market conditions. Thus, investors must monitor the CPI, real activity rate and REER closely, so the appreciation of the returns is experienced by investors, which includes companies that form part of the effected JSE selected indices in their portfolio. Moreover, having found interest rates to have a significant negative effect on selected index returns under changing market conditions, it is essential that investors develop strategies on how to deal with the changing effect of interest rate risk on stock market returns instead of assuming a linear effect. It is further noted that the effect that macroeconomic variables have on stock market returns vary under changing market conditions. Thus, investors should consider bull and bear market conditions when making informed decisions regarding investments on the JSE, as it is an important determinant of stock market returns and inevitably influences investors’ returns.

5.5.3. Future Studies

The study provided an important aspect for future research of this kind in the SA context. It was noted that no study has analysed the changing effect of macroeconomic variables on stock indices in SA. The study brought an important and fundamental aspect of AMH to the SA literature. In an attempt to enhance the study, it is recommended that scholars’ control for stock market volatility and incorporate other macroeconomic variables such as the SA unemployment rate, among others. Moreover, future studies may consider using nonlinear models that can capture a long-run switching relationship between macroeconomic variables and JSE indices.

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APPENDIX LIST

Appendix A: Company Classification

The Consumable Goods 3000 index		
Anheuser-Busch InBev SA NV	Astral Foods Ltd	AVI Ltd
British American Tobacco plc	Compagnie Fin Richemont	Distell Group Holdings Ltd
Libstar Holdings Ltd	Metair Investments Ltd,	Oceana Group Ltd
RCL Foods Ltd	RFG Holdings Ltd	Tiger Brands Ltd
The Consumable Service 5000 index		
BID Corporation Ltd	City Lodge Hotels Ltd	Clicks Group Ltd
Curro Holdings Limited	Cashbuild Ltd	Dis-Chem Pharmacies Ltd
Famous Brands Ltd	Italtile Ltd	Lewis Group Ltd
MultiChoice Group Ltd	Mr Price Group Ltd	Massmart Holdings Ltd
Motus Holdings Ltd	Pick n Pay Stores Ltd	Pepkor Holdings Ltd
Shoprite Holdings Ltd	Steinhoff Int Holdings N.V	The Spar Group Ltd
Sun International Ltd	Spur Corporation Ltd	The Foschini Group Ltd
Tsogo Sun Hotels LTD	Truworths Int Ltd	Tsogo Sun Gaming Ltd
Woolworths Holdings Ltd	ADvTECH Ltd	
The Financials 800 Index		
Absa Group Limited	Alexander Forbes Grp Hldgs	Arrowhead Prop Ltd B
African Rainbow Cap Inv	Attacq Limited	Brait SE
Brimstone Inv Corp Ltd-N	Capital Counties Prop plc	Coronation Fund Mngrs Ld
Capitec Bank Hldgs Ltd	Discovery Ltd	Emira Property Fund Ltd
EPP N.V.	Equites Prop Fund Ltd	Fortress REIT Ltd A
Fortress REIT Ltd B	Firstrand Ltd	Growthpoint Prop Ltd
Hosken Cons Inv Ltd	Hammerson plc	Hospitality Prop Fund B
Hyprop Inv Ltd	Investec Australia Prop Fd	Investec Ltd
Investec plc	Investec Property Fund Ltd	Intu Properties plc
JSE Ltd	PSG Konsult Limited	Liberty Two Degrees LTD
Long 4 Life Limited	Liberty Holdings Ltd	Lighthouse Capital Ltd
MAS Real Estate Inc.	Momentum Met Hldgs Ltd	Ninety-One Plc
Nedbank Group Ltd	NEPI Rockcastle Plc	Ninety-One Limited
Octodec Invest Ltd	Old Mutual Limited	Peregrine Holdings Limited
PSG Group Ltd	Quilter Plc	Redefine Properties Ltd
Remgro Ltd	Resilient REIT Limited	Resilient REIT Limited

Rand Merchant Inv Hldgs Ltd	Reinet Investments S.C.A	RDI REIT P.L.C
SA Corp Real Estate Ltd	Standard Bank Group Ltd	Sanlam Limited
Santam Limited	Sirius Real Estate Ltd	Stor-Age Prop REIT Ltd
Stenprop Limited	Transaction Capital Ltd	Vukile Property Fund Ltd
Zeder Inv Ltd		

Data Source: Infront Database

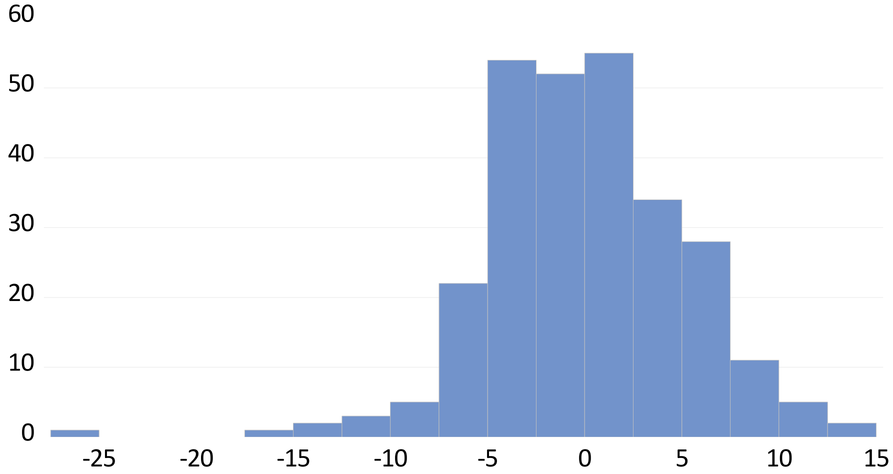
Appendix B: EViews Unit Root and Stationarity Test Results

ADF Test							
Level of Significance	1 Percent	5 Percent	10 Percent	N/A			
Critical Values	-3.454085	-2.871883	-2.572354				
Stock Market Series							
	JSE_ALSI	INU_IND	CONG_IND	CONS_IND	TELCOM_IND	FIN_IND	TECH_IND
Test Statistic	-17.02791	-9.976591	-18.03026	-14.54652	-15.61842	-16.41578	-14.60755
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Macroeconomic Series							
	CPI	M2	ST_INT	LT_INT	INU_PRO	REER	N/A
Test Statistic	-12.13503	-17.72441	-10.82755	-12.88128	-3.335514	-12.71373	
Probability	0.0000	0.0000	0.0000	0.0000	0.0143	0.0000	
PP Test							
Level of Significance	1 Percent	5 Percent	10 Percent	N/A			
Critical Values	-3.454085	-2.871883	-2.572354				
Stock Market Series							
	JSE_ALSI	INU_IND	CONG_IND	CONS_IND	TELCOM_IND	FIN_IND	TECH_IND
Test Statistic	-17.05740	-16.38597	-18.02710	-14.43364	-15.63985	-16.53592	-14.64029
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Macroeconomic Series							
	CPI	M2	ST_INT	LT_INT	INU_PRO	REER	N/A
Test Statistic	-12.13503	-17.68524	-10.81027	-12.56174	-7.297784	-13.63817	
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
KPSS Test							
Level of Significance	1 Percent	5 Percent	10 Percent	N/A			
Critical Values	0.739000	0.463000	0.347000				
Stock Market Series							
	JSE_ALSI	INU_IND	CONG_IND	CONS_IND	TELCOM_IND	FIN_IND	TECH_IND
LM Statistic	0.087116	0.116514	0.139282	0.326538	0.199682	0.054679	0.134414
Macroeconomic Series							
	CPI	M2	ST_INT	LT_INT	INU_PRO	REER	N/A
LM Statistic	0.118327	1.095453	0.092820	0.171052	0.246766	0.069354	
ADF Breakpoint Test							
Level of Significance	1 Percent	5 Percent	10 Percent	N/A			
Critical Values	-4.949133	-4.443649	-4.193627				
Stock Market Series							

	JSE_ALSI	INU_IND	CONG_IND	CONS_IND	TELCOM_IND	FIN_IND	TECH_IND
Test Statistic	18.27055	-16.47014	-18.74386	-15.93031	-16.16389	-16.96777	-15.74037
Probability	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Macroeconomic Series							
	CPI	M2	ST_INT	LT_INT	INU_PRO	REER	N/A
Test Statistic	-12.63823	-18.98069	-11.89965	-13.31662	-7.505621	-14.07304	
Probability	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	

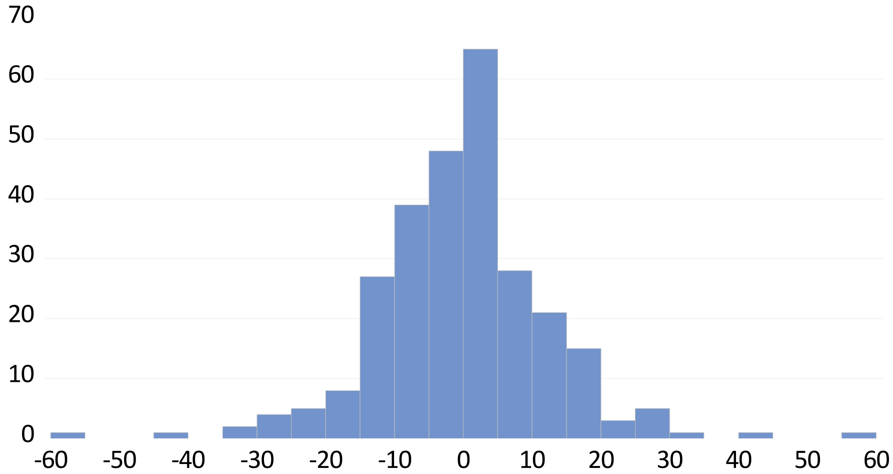
Appendix C: EViews Jarque-Bera Test Results

Ci. JSE All-Share Index



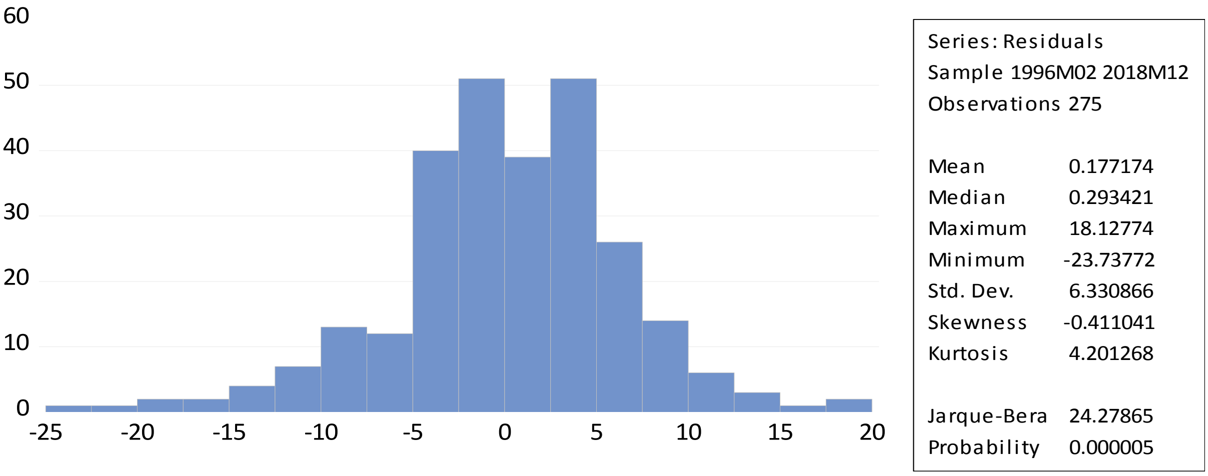
Series: Residuals	
Sample 1996M02 2018M12	
Observations 275	
Mean	-0.018126
Median	-0.121089
Maximum	13.47225
Minimum	-26.77049
Std. Dev.	5.080396
Skewness	-0.499339
Kurtosis	5.632860
Jarque-Bera	90.85667
Probability	0.000000

Cii. Industrial Metal and Mining Index

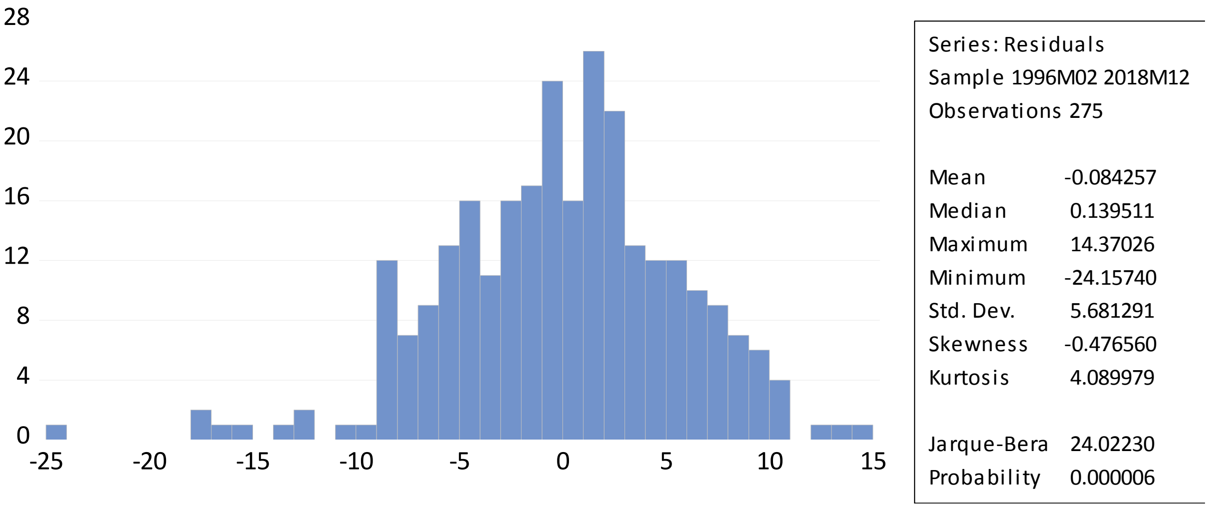


Series: Residuals	
Sample 1996M02 2018M12	
Observations 275	
Mean	-0.041245
Median	0.353310
Maximum	55.51425
Minimum	-57.15614
Std. Dev.	12.53379
Skewness	-0.001312
Kurtosis	6.169773
Jarque-Bera	115.1273
Probability	0.000000

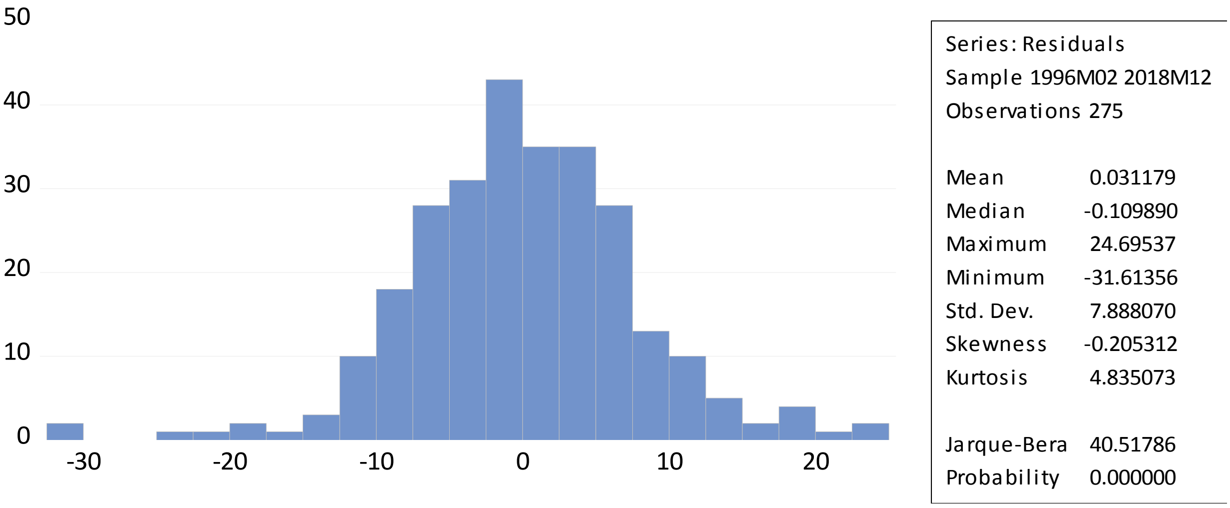
Ciii. Consumable Goods Index



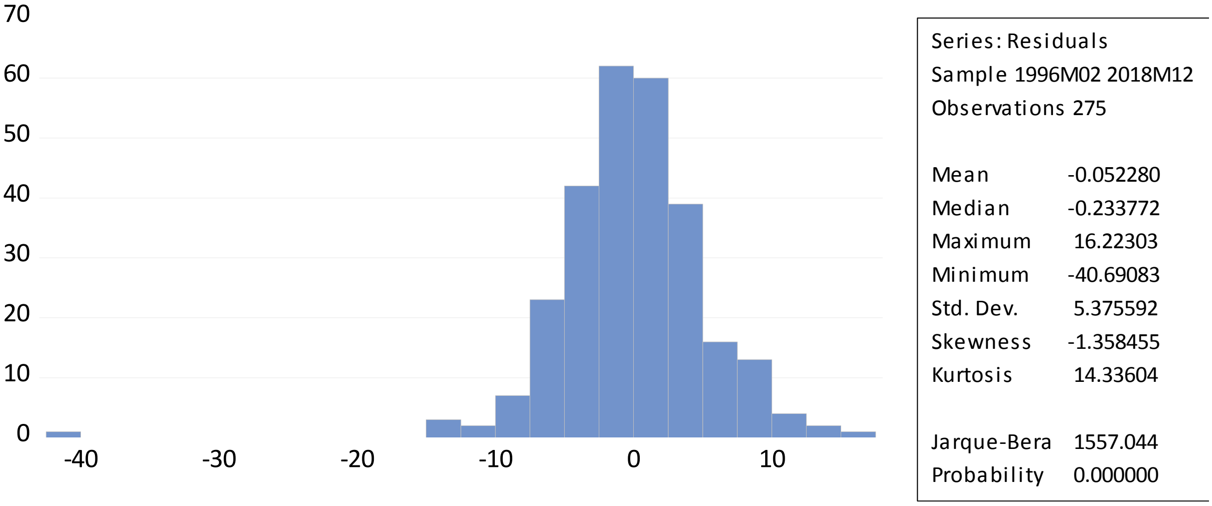
Civ. Consumable Service Index



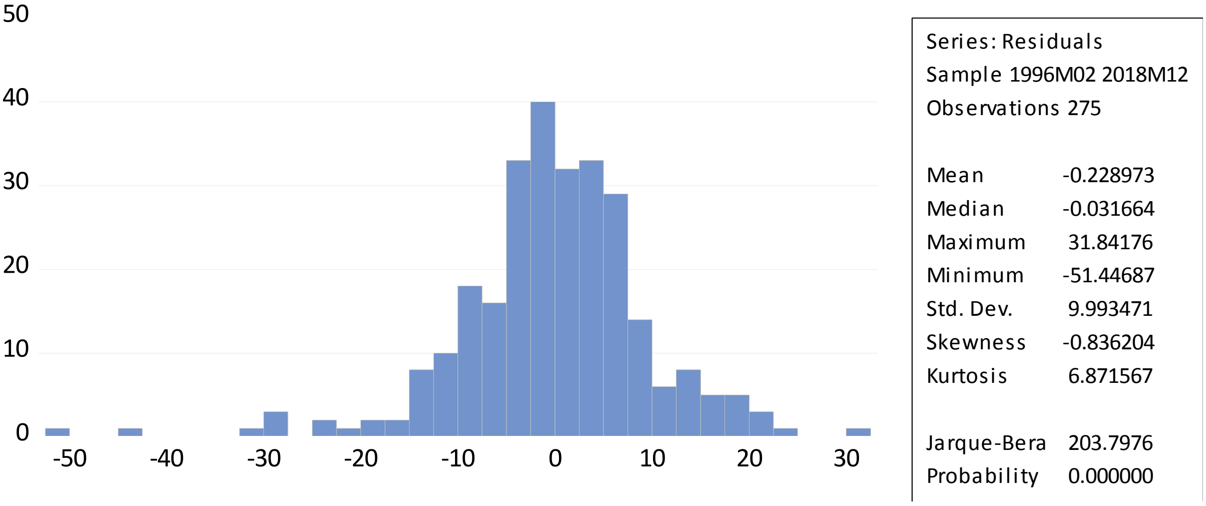
Cv. Telecommunication Index



Cvi. Financials Index



Cvii. Technologies Index



Appendix D: EViews Markov Regime-Switching Results

Di. JSE All-Share Index

Dependent Variable: JSE_ALSI				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Date: 05/03/20 Time: 22:04				
Sample: 1996M02 2018M12				
Included observations: 275				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard deviation (rng=kn, seed=1559391618)				
Convergence achieved after 17 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
CPI	-0.458833	0.753612	-0.608845	0.5426
M2	-0.030488	0.201722	-0.151140	0.8799
ST_INT	-0.003745	0.103666	-0.036126	0.9712
LT_INT	-0.323331	0.112608	-2.871307	0.0041
INU_PRO	0.040285	0.373759	0.107783	0.9142
REER	-0.109024	0.118962	-0.916462	0.3594
C	1.317447	0.498344	2.643653	0.0082
LOG(SIGMA)	1.225450	0.059407	20.62800	0.0000
Regime 2				
CPI	-1.151739	1.403638	-0.820539	0.4119
M2	0.256162	0.512887	0.499452	0.6175
ST_INT	-0.396714	0.160072	-2.478343	0.0132
LT_INT	-0.182730	0.236872	-0.771432	0.4405
INU_PRO	2.161161	1.152279	1.875553	0.0607
REER	0.006400	0.215891	0.029645	0.9764
C	-1.223804	1.416306	-0.864082	0.3875
LOG(SIGMA)	1.952688	0.079559	24.54377	0.0000
Transition Matrix Parameters				
P11-C	4.386679	0.778134	5.637435	0.0000
P21-C	-3.558845	0.700306	-5.081845	0.0000
Mean dependent var	0.784759	S.D. dependent var		5.340262
S.E. of regression	5.225472	Sum squared resid		7072.138
Durbin-Watson stat	2.225399	Log likelihood		-809.3887
Akaike info criterion	6.017373	Schwarz criterion		6.254107
Hannan-Quinn criter.	6.112381			

Dii. Industrial Metal and Mining Index

Dependent Variable: INU_IND				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Date: 05/03/20 Time: 22:36				
Sample: 1996M02 2018M12				
Included observations: 275				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard deviation (rng=kn, seed=1207526702)				
Convergence achieved after 44 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
CPI	-0.094343	1.540450	-0.061244	0.9512
M2	-0.741866	0.453098	-1.637320	0.1016
ST_INT	-0.075213	0.197403	-0.381013	0.7032
LT_INT	0.124344	0.225774	0.550746	0.5818
INU_PRO	0.172175	0.911778	0.188834	0.8502
REER	-0.015479	0.249251	-0.062101	0.9505
C	1.398042	1.127522	1.239924	0.2150
LOG(SIGMA)	2.182495	0.055192	39.54378	0.0000
Regime 2				
CPI	15.30382	7.750081	1.974666	0.0483
M2	-1.269841	2.393612	-0.530512	0.5958
ST_INT	0.696203	0.917416	0.758874	0.4479
LT_INT	-1.589235	1.451505	-1.094888	0.2736
INU_PRO	9.873365	6.128993	1.610928	0.1072
REER	-0.018581	1.176855	-0.015789	0.9874
C	-15.37057	7.842753	-1.959843	0.0500
LOG(SIGMA)	3.043986	0.121909	24.96932	0.0000
Transition Matrix Parameters				
P11-C	3.394668	0.528159	6.427357	0.0000
P21-C	-1.583290	0.567695	-2.788979	0.0053
Mean dependent var	0.563171	S.D. dependent var		12.85725
S.E. of regression	12.89169	Sum squared resid		43044.70
Durbin-Watson stat	2.060265	Log likelihood		-1052.440
Akaike info criterion	7.785021	Schwarz criterion		8.021755
Hannan-Quinn criter.	7.880029			

Diii. Consumable Goods Index

Dependent Variable: CONG_IND				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Date: 05/03/20 Time: 22:51				
Sample: 1996M02 2018M12				
Included observations: 275				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard				
deviation (rng=kn, seed=190573804)				
Failure to improve objective (non-zero gradients) after 0 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
CPI	0.324558	1.034972	0.313591	0.7538
M2	0.427425	0.326202	1.310307	0.1901
ST_INT	0.082606	0.092775	0.890391	0.3733
LT_INT	-0.051359	0.139965	-0.366938	0.7137
INU_PRO	-0.001110	0.453587	-0.002448	0.9980
REER	0.459841	0.143792	3.197949	0.0014
C	1.329003	0.699985	1.898616	0.0576
LOG(SIGMA)	0.957740	0.141414	6.772620	0.0000
Regime 2				
CPI	-2.420721	1.400955	-1.727908	0.0840
M2	-0.032466	0.449186	-0.072276	0.9424
ST_INT	-0.375168	0.196665	-1.907653	0.0564
LT_INT	-0.137172	0.244975	-0.559942	0.5755
INU_PRO	1.003071	1.015291	0.987964	0.3232
REER	-0.517287	0.237387	-2.179091	0.0293
C	0.729396	1.177747	0.619314	0.5357
LOG(SIGMA)	2.020184	0.069443	29.09123	0.0000
Transition Matrix Parameters				
P11-C	0.563494	0.569415	0.989601	0.3224
P21-C	-1.174464	0.549269	-2.138231	0.0325
Mean dependent var	1.062177	S.D. dependent var		6.530527
S.E. of regression	6.530724	Sum squared resid		11046.44
Durbin-Watson stat	2.264464	Log likelihood		-880.5802
Akaike info criterion	6.535129	Schwarz criterion		6.771863
Hannan-Quinn criter.	6.630137			

Div. Consumable Service Index

Dependent Variable: CONS_IND				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Date: 05/04/20 Time: 10:28				
Sample: 1996M02 2018M12				
Included observations: 275				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard				
deviation (rng=kn, seed=1773637159)				
Convergence achieved after 27 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
CPI	-2.500763	3.363801	-0.743434	0.4572
M2	-0.271111	0.744954	-0.363930	0.7159
ST_INT	-0.562860	0.317306	-1.773873	0.0761
LT_INT	-0.960031	0.809399	-1.186103	0.2356
INU_PRO	-0.575907	1.572341	-0.366273	0.7142
REER	-0.992233	1.095168	-0.906010	0.3649
C	0.327074	3.610968	0.090578	0.9278
LOG(SIGMA)	2.016619	0.098177	20.54073	0.0000
Regime 2				
CPI	-1.830623	1.789297	-1.023096	0.3063
M2	-0.140995	0.448324	-0.314494	0.7531
ST_INT	0.021393	0.117322	0.182341	0.8553
LT_INT	-0.373207	0.197344	-1.891155	0.0586
INU_PRO	-0.234279	0.921371	-0.254272	0.7993
REER	0.323451	0.218875	1.477787	0.1395
C	2.805249	0.755859	3.711340	0.0002
LOG(SIGMA)	1.548957	0.225351	6.873532	0.0000
Transition Matrix Parameters				
P11-C	3.237844	1.086332	2.980530	0.0029
P21-C	-4.288509	1.864202	-2.300453	0.0214
Mean dependent var	1.073419	S.D. dependent var		6.483329
S.E. of regression	5.844148	Sum squared resid		8845.902
Durbin-Watson stat	2.010546	Log likelihood		-859.7649
Akaike info criterion	6.383745	Schwarz criterion		6.620479
Hannan-Quinn criter.	6.478753			

Dv. Telecommunication Index

Dependent Variable: TELCOM_IND				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Date: 05/04/20 Time: 10:52				
Sample: 1996M02 2018M12				
Included observations: 275				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard deviation (rng=kn, seed=1234052056)				
Convergence achieved after 24 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
CPI	0.062689	1.237919	0.050640	0.9596
M2	0.496667	0.316231	1.570587	0.1163
ST_INT	-0.196742	0.151788	-1.296162	0.1949
LT_INT	-0.444862	0.176262	-2.523868	0.0116
INU_PRO	0.102938	0.625565	0.164552	0.8693
REER	0.333261	0.154552	2.156298	0.0311
C	0.336345	0.855309	0.393245	0.6941
LOG(SIGMA)	1.818503	0.101942	17.83866	0.0000
Regime 2				
CPI	2.510174	6.921460	0.362665	0.7169
M2	-1.471199	2.293708	-0.641407	0.5213
ST_INT	0.007757	0.607656	0.012766	0.9898
LT_INT	-2.104191	1.145831	-1.836389	0.0663
INU_PRO	6.688758	6.358103	1.052005	0.2928
REER	-0.853388	1.803964	-0.473062	0.6362
C	-5.351819	7.002600	-0.764262	0.4447
LOG(SIGMA)	2.646424	0.169273	15.63403	0.0000
Transition Matrix Parameters				
P11-C	3.876770	1.444321	2.684147	0.0073
P21-C	-1.783772	1.035244	-1.723044	0.0849
Mean dependent var	0.769882	S.D. dependent var		8.645459
S.E. of regression	8.113305	Sum squared resid		17048.86
Durbin-Watson stat	2.042617	Log likelihood		-934.6958
Akaike info criterion	6.928697	Schwarz criterion		7.165431
Hannan-Quinn criter.	7.023705			

Dvi. Financials Index

Dependent Variable: FIN_IND				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Date: 05/04/20 Time: 11:21				
Sample: 1996M02 2018M12				
Included observations: 275				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard deviation (rng=kn, seed=1808684864)				
Convergence achieved after 25 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
CPI	0.416042	0.692585	0.600709	0.5480
M2	0.276072	0.203273	1.358134	0.1744
ST_INT	-0.028902	0.093101	-0.310432	0.7562
LT_INT	-0.435512	0.106546	-4.087558	0.0000
INU_PRO	-0.013551	0.364138	-0.037214	0.9703
REER	0.135396	0.106638	1.269677	0.2042
C	0.822196	0.460101	1.786990	0.0739
LOG(SIGMA)	1.175949	0.060686	19.37756	0.0000
Regime 2				
CPI	0.650320	1.699541	0.382644	0.7020
M2	-0.266601	0.654940	-0.407061	0.6840
ST_INT	-0.320343	0.188312	-1.701130	0.0889
LT_INT	-0.665214	0.300417	-2.214299	0.0268
INU_PRO	1.042385	1.358128	0.767516	0.4428
REER	-0.015354	0.277309	-0.055368	0.9558
C	-1.699964	1.923294	-0.883882	0.3768
LOG(SIGMA)	2.092807	0.084758	24.69159	0.0000
Transition Matrix Parameters				
P11-C	4.327412	0.785497	5.509140	0.0000
P21-C	-3.392617	0.739399	-4.588346	0.0000
Mean dependent var	0.648830	S.D. dependent var		5.958573
S.E. of regression	5.529328	Sum squared resid		7918.528
Durbin-Watson stat	2.315782	Log likelihood		-809.3040
Akaike info criterion	6.016756	Schwarz criterion		6.253490
Hannan-Quinn criter.	6.111764			

Dvii. Technologies Index

Dependent Variable: TECH_IND				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Date: 05/04/20 Time: 12:12				
Sample: 1996M02 2018M12				
Included observations: 275				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard				
deviation (rng=kn, seed=1233140736)				
Convergence achieved after 17 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
CPI	-0.110793	1.619954	-0.068393	0.9455
M2	-0.054280	0.409833	-0.132445	0.8946
ST_INT	-0.196359	0.197831	-0.992560	0.3209
LT_INT	-0.200713	0.229603	-0.874174	0.3820
INU_PRO	-0.645747	0.598915	-1.078194	0.2809
REER	0.397797	0.233899	1.700720	0.0890
C	2.362513	1.125653	2.098793	0.0358
LOG(SIGMA)	1.546542	0.095557	16.18442	0.0000
Regime 2				
CPI	-1.566830	2.351906	-0.666196	0.5053
M2	-0.169936	0.875000	-0.194213	0.8460
ST_INT	-0.068962	0.285830	-0.241269	0.8093
LT_INT	-0.254240	0.447500	-0.568135	0.5699
INU_PRO	0.386247	1.870124	0.206536	0.8364
REER	-0.291654	0.407141	-0.716346	0.4738
C	-0.390657	2.529904	-0.154416	0.8773
LOG(SIGMA)	2.589027	0.072711	35.60701	0.0000
Transition Matrix Parameters				
P11-C	3.307679	0.604530	5.471487	0.0000
P21-C	-3.324876	0.678746	-4.898559	0.0000
Mean dependent var	0.397011	S.D. dependent var		10.29762
S.E. of regression	10.37975	Sum squared resid		27904.44
Durbin-Watson stat	1.815561	Log likelihood		-981.2915
Akaike info criterion	7.267574	Schwarz criterion		7.504309
Hannan-Quinn criter.	7.362583			

Appendix E: EViews Markov Regime-Switching Transition Probabilities and Constant Expected Duration Results

	Transition Probabilities													
	JSE_ALSI		INU_IND		CONG_IND		CONS_IND		TELCOM_IND		FIN_IND		TECH_IND	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	0.987711	0.012289	0.967537	0.032463	0.637261	0.362739	0.962234	0.037766	0.979703	0.020297	0.986970	0.013030	0.964691	0.035309
2	0.027683	0.972317	0.170330	0.829670	0.236049	0.763951	0.013540	0.986460	0.143838	0.856162	0.032527	0.967473	0.034728	0.965272
Constant Expected Duration														
	JSE_ALSI		INU_IND		CONG_IND		CONS_IND		TELCOM_IND		FIN_IND		TECH_IND	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	81.37306	36.12261	30.80474	5.870955	2.756800	4.236409	26.47874	73.85777	49.26806	6.952265	76.74801	30.74368	28.32165	28.79556

Appendix F: Ethical Clearance Form

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Mr Fabian Moodley (214582814)
School Of Acc Economics&Fin
Westville

Dear Mr Fabian Moodley,

Protocol reference number: 00004748
Project title: Effect of Macroeconomic Variables on Stock Returns under Changing Market Conditions: Evidence from the Johannesburg Stock Exchange (JSE) Sectors

Exemption from Ethics Review

In response to your application received on 11 November 2019, your school has indicated that the protocol has been granted **EXEMPTION FROM ETHICS REVIEW.**

Any alteration/s to the exempted research protocol, e.g., Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through an amendment/modification prior to its implementation. The original exemption number must be cited.

For any changes that could result in potential risk, an ethics application including the proposed amendments must be submitted to the relevant UKZN Research Ethics Committee. The original exemption number must be cited.

In case you have further queries, please quote the above reference number.

PLEASE NOTE:
Research data should be securely stored in the discipline/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours sincerely,

14 Nov 2019

Prof Josue Mbonigaba
Academic Leader Research
School Of Acc Economics&Fin

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS