MASTERS THESIS

# ANALYSIS OF THE RELATIONSHIP BETWEEN CHANGES IN MACROECONOMIC VARIABLES AND VARIOUS SECTOR PRICE INDICES OF JSE

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**DEPARTMENT OF ECONOMICS AND ECONOMIC HISTORY**

A thesis in partial fulfilment of the requirements of:

**MASTER OF COMMERCE IN FINANCIAL MARKETS**

(Half thesis)

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DECEMBER 2019

RHODES UNIVERSITY

## PLAGIARISM DECLARATION

I, Tungamirai Chisvuvo Mapanda, do declare that except for references specifically indicated in the text and such help as has been provided to me by my supervisors, that this thesis is wholly my own work and has not been submitted at any other University or Technikon for any degree purposes.

Signed by_____on this 23th day of December 2019

## ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratitude to God for his infinite mercy, grace and favour during the period of this study without which I would not have been able to complete this work.

I would like to express my deep and sincere gratitude to my research supervisor, Prof Gavin Keeton and Co-Supervisor, Dr Alwyn Khumalo for giving me the opportunity to do research and providing invaluable guidance towards the completion of this thesis.

I am extremely grateful to my parents for their love, prayers, caring and sacrifices for educating and preparing me for the future. I will also like to thank my sister, Kuzivakwashe Mapanda for her support and valuable prayers. Also I express my thanks to Ailie Charteris, Delon Tarentaal, Prof Juniours Marire and Tinashe Hofisi for the keen interest shown to complete this thesis successfully.

## ABSTRACT

**Purpose-** The purpose of this paper is to analyse the relationship between changes in domestic macroeconomic variables and various indices of the JSE during the full time period, June 1995 to December 2018 and the sub-periods, June 1995 to June 2007 and July 2007 to December 2018.

**Design/ methodology/ approach**- The paper employs the Autoregressive Distributed Lag (ARDL) model approach to cointegration using monthly data from June 1995 to December 2018.

**Findings-** In terms of the **long run**, the results show that the coincident indicator measure of domestic economic activity is positively and significantly related to the various JSE indices for all study periods. In terms of inflation, the results show no relationship between inflation rate and the various indices for both whole period and June 1995 to June 2007 sub period. However for the July 2007 to December 2018 sub period, JSE All Share Index and JSE Top 40 Index are negatively related. For the real effective exchange rate, only the Consumer Services Index is positively related to the exchange rate in terms of June 1995 to June 2007 sub period. However, JSE All Share Index and JSE Top 40 Index are negatively related to the exchange rate in all study periods. In terms of the short term interest rate, for the whole period, JSE All Share Index, JSE Top 40 Index, Health Care Index and Telecommunications Index are negatively related to interest rate. In terms of the June 1995 to June 2007 sub period, JSE All Share Index and Industrials Index are negatively related to the short term interest rate. For the July 2007 to December 2018 sub period, Telecommunications Index and Technology Index are negatively related.

In terms of the **short run**, the coincident indicator is positively and significantly related to the various JSE indices for all study periods. Inflation is not significantly related to any index in the whole period. In terms of the June 1995 to June 2007 sub period, Industrials Index and Financials Index are positively related to inflation and in the July 2007 to December 2018 sub period, Consumer Goods Index, Health Index and Consumer Services Index are negatively related to the inflation rate. The real effective exchange rate is positively and significantly related to the various JSE indices in the different study periods. In terms of the short term interest rate, for the whole period and the June 1995 to June 2007 sub period only the Technology Index is not significantly and negatively related to the short term interest rate, but for the July 2007 to December 2018 sub period, Top 40 Index, Telecommunications Index and

Technology Index are positively related to the interest rate. Only the Financial Index is negatively related to short term interest rates during this sub period.

**Research Limitations-** Not a lot literature was found on the relationship between macroeconomic variables and the various sector indices of the JSE. Most previous work, in the South African context focused just on the JSE All Share Index.

**Practical Implications-** The findings can help investors diversify their portfolios into indices that benefit from expected changes in macroeconomic variables, such as recessions, rising interest rates, rising inflation or a weakening exchange rate. Alternatively, they can hedge themselves against the negative implications of such macroeconomic changes on portfolio performance. In addition, the findings are important for the monetary authorities to better understand the implications of their policy changes on financial markets.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| ADF | Augmented Dickey Fuller |
| ALSI | All Share Index |
| AMEX | American Stock Exchange |
| ANOVA | Analysis Of Variance |
| APT | Arbitrage Pricing Theory |
| ARDL | Augmented Autoregressive General Conditional Heteroscedasticity |
| ASE | Amman Stock Exchange |
| ASX | Australian Stock Exchange |
| BSE | Bombay Stock Exchange |
| BSE SENSEX | 30 largest and most actively traded stocks on Bombay Stock Exchange |
| BRIC | Brazil, Russia, India, and China |
| CAPM | Capital Asset Pricing Model |
| CI | Coincident Indicator |
| CPI | Consumer Price Index |
| D | Dummy Variable |
| DAX 30 | Germany Stock Market |
| DCF | Discounted Cash Flow |
| DDM | Dividend Discount Model |
| DJIA | Dow Jones Industrial Index |
| ECM | Error Correction Model |
| ECT | Error Correction Term |
| EG | Engle-Granger |
| EGARCH | Exponential General Conditional Heteroscedasticity |
| EM | Emerging Markets |
| EMH | Efficient Market Hypothesis |
| EU | European Union |
| FDI | Foreign Direct Investment |
| FINI | Financial 15 Index |
| FTSE | Financial Times Stock Exchange |
| FTSE 100 | Financial Times Stock Exchange 100 Index |
| GARCH | General Conditional Heteroscedasticity |

| | |
|---|---|
| GARCH | Generalized Autoregressive Conditional Heteroscedasticity |
| GDP | Gross Domestic Product |
| GGM | Gordon Growth Model |
| GNP | Gross National Product |
| GSE | Ghana Stock Exchange |
| ICAPM | Intertemporal Capital Asset Pricing Model |
| ICB | International Classification Benchmark |
| INDI 25 | Industrial 25 Index |
| INDI | Industrial Index |
| INET BFA | INET Bureau 25 Of Financial Analysis |
| INF | Inflation rate |
| ISE | Istanbul Stock Exchange |
| J200 | JSE Top 40 |
| J203 | JSE All Share Index |
| J510 | JSE Basic Materials Index |
| J520 | JSE Industrials Index |
| J530 | JSE Consumer Goods Index |
| J540 | JSE Health Care Index |
| J550 | JSE Consumer Services Index |
| J560 | JSE Telecommunications Index |
| J580 | JSE Financials Index |
| J590 | JSE Technology Index |
| JCI | Jarkata Composite Index |
| JSE | Johannesburg Stock Exchange |
| KPSS | Kwiatkowski Phillips Schmidt Shin |
| KSE 100 | Karachi Stock Exchange |
| LM | Lagrange Multiplier |
| LR | Likelihood Ratio |
| LSE | London stock exchange |
| LSE25 index | Lahore Stock Exchange |
| MINT | Mexico, Indonesia, Nigeria and Turkey |
| NSE | Nairobi Stock Exchange |
| NSE | Nigerian Stock Exchange |
| NIKKEI 225 | Nikkei Stock Average |

| | |
|---|---|
| NYSE | New York Stock Exchange |
| NZSE | New Zealand Stock Exchange |
| OLS | Ordinary Least Squares |
| OMXS30 | Stockholm Stock Exchange |
| PP | Phillip Perron |
| PPI | Producer Price Index |
| PVM | Present Value Model |
| RESI 10 | Resource 10 Index |
| S & P 500 | Standard & Poor 500 Index |
| SA | South Africa |
| SARB | South African Reserve Bank |
| ST | Short term interest rate |
| REER | Real Effective Exchange Rate |
| T-Bill | Treasury bill rate |
| UK | United Kingdom |
| US | United States |
| USD | United States Dollar |
| VAR | Vector Auto Regression |
| VARMA | Vector Autoregressive Moving Average |
| VD | Variance Decomposition |
| VECM | Vector Error Correction Model |
| ZAR | South African Rand |

# CHAPTER 1: INTRODUCTION

*The stock market is a place where people can get rich or poor quickly*

*(Ajayi and Olaniyan, 2016)*

## 1.1 Background

The performance of the equity market is an important indicator of an economy's financial health and development. Stock markets provide businesses with access to capital and investors with opportunities for capital preservation and growth by channelling surplus funds of savers to borrowers (Ross, 1976). Stock markets enables optimum allocation and utilization of scarce capital resources and provide the base for long term sustainable economic growth (Hackland, 2016). Additionally, apart from channelling funds, stock markets provide valuation of stocks, price discovery in financial assets and improve stock liquidity (Junkin, 2011).

Basic supply and demand factors can affect equity share prices. The supply of stock is created by the number of shares firms' issue, the demand is based on investors who want to buy shares from new issues or from shareholders who already own them (Al-Shubiri, 2010). For example, if demand for a share/stock rises its price increases and if investors start selling shares its price goes down (Al-Shubiri, 2010). Besides supply and demand, according to Hancocks (2010), MacFarlane (2011) and Afordofe (2012), macroeconomic factors, including inflation, interest rates, exchange rates, economic growth, industrial production and oil prices, can affect share prices by improving or worsening the economic environment in which companies operate.

The theoretical framework underpinning how changes in the macro economy are transmitted into stock prices is provided by models such as Intertemporal Capital Asset Pricing Model, Present Value Model (and its later derivation the Gordon Growth Model), Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT) and Efficient Market Hypothesis (Gordon (1959), Sharpe (1964), Merton (1973), Ross (1976) and Fama and French (2004).

Such models explain how any anticipated or unanticipated arrival of new information about macroeconomic variables (e.g. GDP, industrial production, inflation, interest rate, exchange rate, etc.) will indirectly affect stock prices through its impact on the expected future dividend streams, the discount rate, or both. Economic factors affect the discount rates, companies' ability to generate cash flows, as well as future dividend payouts. Thus, the macroeconomic

variables may become a key driver of underlying company returns. These returns should then influence the intrinsic price of a share and therefore an observable relationship should be expected between share prices and changes in such variables.

Various studies have attempted to understand the relationship between macroeconomic variables and stock markets (MacFarlane, 2011 and Afordofe, 2012). In terms of international empirical evidence, Maghyereh (2002), Samadi *et al.* (2012) and Al-Majali and Al-Assaf (2014) found a strong relationship between macroeconomic variables and the stock markets. African countries studies excluding South Africa, Abdulrahim (2011) and Ouma and Muriu (2014) also found a relationship between the macroeconomic variables and stock market.

Domestic macroeconomic variables may affect various sectors of the JSE differently. This has been proven by various researchers like Coetzee (2002), who found statistically significant evidence of a negative relationship between quarterly monetary variables such as inflation, short-term interest rate and rand-dollar exchange rate and stock prices.

Banda (2017) investigated the causal relationships (long run and short run) between the JSE Industrial Index 25 (INDI 25) and gross domestic product (GDP), inflation (CPI), prime rates and exchange rates. Banda (2017) found that interest rates have a negative relationship on the INDI 25, Exchange rates have a positive effect, but there is no relationship between the INDI 25 and GDP. Due to increased integration of financial markets due to globalization, not only domestic macroeconomic variables affect the South African stock market but foreign macroeconomic variables as well (Olalere, 2006 and Junkin, 2011). Olalere (2006) found that foreign GDP influences the long-run behaviour of the SA stock market index and Junkin (2011) found that United States GDP (a proxy for foreign GDP) has a positive relationship only with the Pharmaceuticals Index, however, negatively related to Construction and Material Index, Financial Index, Food Producers Index, General Retail Index and Mining Index.

## 1.2 Justification of Study

Most past studies have focused on the relationship between domestic macroeconomic variables and aggregate stock market indices (Moolman and Du Toit, 2005, Mangani, 2009, Bonga-Bonga and Makakabule, 2010, MacFarlane, 2011, Junkin, 2011 and Eita, 2012). However, there has been little research on how domestic or global macroeconomic variables might differently influence sub-sector indices of the JSE. Afordofe (2012) argues that individual stock market sectors may have unique relationships with macroeconomic variables.

Thus, whilst analysing the relationship between macroeconomic variables and share returns using a broad market index (composed of companies in various sectors) is informative, the overall result does not reveal sector specific information that may be different because of specific sector fundamentals and unique correlations between different sector share prices and macroeconomic variables that may be concealed in the overall index. Such differences are important as they offer additional opportunities for outperformance or hedging of risk not available in the overall index alone.

Studies on the relationship between different sectors of the JSE and macroeconomic variables have been carried out by Hancocks (2010) and Banda (2017). Both found that macroeconomic variables do have an impact on the stock market. Hancocks (2010) investigated the extent to which inflation, long and short-term interest rates, money supply and exchange rates (Rand/US) influence stock market prices on the All-Share, Financial, Mining and Retail Indices of the Johannesburg Stock Exchange. The study found that money supply, inflation, long and short- run interest rates, and the exchange rate all had an influence on stock market prices. Banda (2017) investigated the long run and short run causal relationships between the Industrial Index 25 and some macroeconomic variables (GDP, inflation, prime overdraft rate and exchange rates) in South Africa. The results found a positive and significant relationship between the INDI 25 and inflation, a positive but insignificant relationship with the exchange rate and no relationship with GDP.

This study aims to extend previous research investigating the influence that domestic macroeconomic variables have on various sector indices of the JSE. Both previous studies (Hancocks, 2010 and Junkin, 2011) were carried out while the impact of the 2007 Global Financial Crisis on macroeconomic variables and stock market performance was at its height. By adding an additional 10 years of data it would be possible to determine whether the relationships between domestic macroeconomic variables have changed in the aftermath of the Crisis. Secondly, more sub-indices of the JSE will be examined than in the previous studies, providing investors with a wider range of possible investment alternatives. Thirdly, in addition to analysing the whole study period June 1995 to December 2018, two sub periods would be created June 1995 to June 2007(pre global crisis) and July 2007 to December 2018 (post crisis) in order to see if there are any changes to the relationship between macroeconomic variables and stock prices before and after the 2007 crisis. Lastly, for this paper a different method would

be used, namely ARDL cointegration, instead of Johansen cointegration used by both Hancocks, 2010 and Junkin, 2011.

## 1.3 Significance of Study

In an uncertain macroeconomic environment understanding the relationship between movements in the stock market and macroeconomic variables is essential. Firstly, it will help investors to make appropriate decisions regarding their stock portfolios for maximum gains. Secondly, businesses may find the findings useful as stock prices are an indication of the financial health of companies and therefore impact on their ability to issue bonds or obtain financing in the future (Afordofe, 2012). Thirdly, policymakers and economists may find understanding these relationships useful, so they can better predict the impact of policy and macroeconomic changes on various sectors of the economy (Cheung and Lai, 1999). Fourthly, an understanding of the relationship between changes in macro variables and different stock market indices will help portfolio management by guiding asset managers in building defensive and well-diversified portfolios to invest in during times of financial crises as well as times of economic growth (Banda, 2017). Well-diversified portfolios contain a large number of individual stocks that are generally uncorrelated with each other and combine to form low-risk portfolios (Banda, 2017).

## 1.4 Goals of the Research

The goal of the research is to examine whether there exist short and long run relationships between changes in domestic macroeconomic variables and sector price indices of the JSE. Specific objectives include:

- To analyse the short and long run impact of domestic short-term interest rate on JSE sector indices.
- To determine the short and long run effect of the real effective exchange rate on JSE sector indices.
- To investigate the short run and long run impact of domestic economic activity on JSE sector indices.
- To determine the short run and long run effect of domestic inflation on JSE.

## 1.5 Methods, Procedures and Techniques

The study period will be from June 1995 to December 2018 using monthly data. Reason for using monthly data is that quarterly data will lose vital information regarding short term changes in stock prices. The source of the various stock price indices will be the INET Bureau of Financial Analysis (INET BFA) and the analysis of the data will be done using Eviews 10. Source for real effective exchange rate and coincident indicator is SARB. Inflation rate was obtained from OECD.Stat. Short term interest rate was obtained from Investing. The macroeconomic variables used were selected based on the frequency they are mentioned in the literature and the various sub-sectors of JSE were selected based on their relative size in terms of market capitalization as well as their importance to the South African economy. Macroeconomic variables employed in this paper are domestic short term interest rate (91-day T-bill rate), inflation rate (CPI), coincident indicator and the real effective exchange rate. JSE indices employed in this paper are JSE All Share Index, JSE Top 40 Index, Basic Materials Index, Industrials Index, Consumer Goods Index, Health Care Index, Consumer Services Index, Telecommunications Index, Financials Index and Technology Index.

In terms of methodology, the paper will differ from Hancocks (2010), Junkin, (2011), Ibrahim and Musah (2014) and Ajayi and Olaniyan (2016), who applied the Johansen cointegration approach. Instead, the ARDL (Autoregressive Distributed Lagged Model) approach to co-integration, a statistical technique followed by Joshi, 2015, Ilahi *et al.*, 2015, Nisha, 2015, Nafees *et al*., 2016, Khalid and Khan, 2017 and Khan and Khan, 2018, will be used. Additionally, the paper will employ dummy variables to account for structural breaks.

Studies like Shah *et al.* (2012), Hamuda *et al.* (2013), Nkoro and Uko (2016) and Ho and Odhiambo (2018) and have proven ARDL approach to co-integration is better than the conventional approach to co-integration such as Engle and Granger (1987), Johansen (1988) and Johansen-Juselius (1990). The advantages of ARDL model are, firstly, that bounds test does not require pre-testing of the series to determine their order of integration since the test can be conducted regardless of whether they are purely I(1), purely I(0), or fractionally integrated (Ho and Odhiambo, 2018). Secondly, ARDL cointegration approach can distinguish explanatory and explained variables, and enables testing the existence of linkage between the underling variables (Azeez and Obalade, 2018). Lastly, as argued in Narayan and Narayan (2004), the small sample properties of the bounds testing approach are far superior to that of other cointegration approaches (Halicioglu, 2007). The approach, therefore, modifies the Auto-

Regressive Distributed Lag (ARDL) framework while overcoming the inadequacies associated with the presence of a mixture of I(0) and I(1) regressors in a Johansen-type framework (Halicioglu, 2007).

Other statistical techniques applied in order to analyse the relationship between stock returns and macroeconomic variables include Augmented Dickey Fuller (ADF) and Phillip Perron (PP) unit root tests, ARDL, and Normal diagnostic test which include Normality, Heteroscedasticity test, Autocorrelation test and Structural test given the wide timeframe.

## 1.6 Hypotheses

Based on the reviewed literature the following hypotheses are proposed for testing purposes:

$H_1$: There is a negative or positive relationship between inflation and stock returns.

$H_2$: There is a positive relationship between coincident indicator and stock returns.

$H_3$: There is a negative relationship between short term interest rate and stock returns.

$H_4$: There is a negative relationship between real effective exchange rate and stock returns.

## 1.7 Assumptions

The movement of the JSE All Share Index, JSE Top 40 Index, Basic Materials Index, Industrials Index, Consumer Goods Index, Health Care Index, Consumer Services Index, Telecommunications Index, Financials Index and Technology Index are used as proxies for the movement in the various sector share prices. The Coincident Indicator is used as a proxy for economic growth because, unlike GDP, data are available monthly. Inflation is measured using changes in the Consumer Price Index (CPI). Domestic 91-day T-bill rate is used as a proxy for short term interest rate. The exchange rate is measured by the Real Effective Exchange Rate.

## 1.8 Limitations to the Study

Firstly, the study did not take into account the presence of other economic factors that may have an effect on the various sectors of the JSE. Secondly, this study was undertaken among shares listed in the JSE and as the study focuses on listed companies, inferences are not made about private South African companies or individual stocks within the various indices (Banda, 2017). Thirdly, only three dummy variables were incorporated in the study to account for

structural breaks, which is not ideal as there is a possibly of more structural breaks. Fourthly, there is not a lot of literature on the relationship between macroeconomic variables and various sector indices especially in the South African context against which the findings of this study can be compared.

## 1.9 Structure Of Dissertation

This study comprises six chapters:

**Chapter 1: Introduction**. This chapter introduces the study and provides a background to the study. Justification of the study, significance of the study, goal of the research, methods, procedures and techniques, hypothesis, assumptions and limitations to the study.

**Chapter 2: Literature Review**. This chapter discusses the theoretical and empirical literature related to this current study. From an empirical analysis perspective, research findings on the relationship between macroeconomic variables and share returns from both international and South African context are discussed.

**Chapter 3: The Behaviour Of JSE All Share Index And Various Sector Indices in South Africa.** This chapter graphically examines the observed relationship between various indices of the JSE and different macroeconomic variables over the study period.

**Chapter 4: Research Methodology and Data.** This chapter explains and motivates the research methodology employed in the study. Furthermore, the chapter discusses the process and tools that were used to analyse the data.

**Chapter 5: Empirical Results.** This chapter reports and synthesises the findings from the data analysis tests.

**Chapter 6: Summary, Conclusion and Recommendations**. This chapter presents a summary of the study, as well as conclusions and recommendations based on the findings. Furthermore, suggestions for future research are proposed.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Theoretical Background

### 2.1.1 Introduction

The theoretical basis of the relationship between macroeconomic variables and share returns has been well documented in financial and economic literature. Gordon (1959), Sharpe (1964), Lintner (1965), Merton (1973) and Ross (1976) have outlined the theoretical basis by which stocks may be valued. Systematic macroeconomic risk factors, which are the basis of this thesis, are integrated into investment decision making through models such as the Efficient Market Hypothesis (EMH), Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT), Discounted Cash Flow Model (DCF) and Intertemporal Capital Asset Pricing Model (ICAPM). These models present a sound theoretical foundation on which the stock market movement may be attributed to the influence of changes in the macroeconomic variables (Junkin, 2011). However, the simplifying assumptions, upon which many of these models are derived and based, present key weaknesses. These weaknesses become increasingly evident in the implementation and practical application of the models (Junkin, 2011). In this section, the theoretical link between macroeconomic variables and share returns is analysed.

### 2.1.2 Efficient Market Hypothesis (EMH)

The Efficient Market Hypothesis developed by Fama (1970), suggests that stock prices adjust rapidly to the arrival of new information, ensuring that current prices reflect all available information about the security. What this means is that is impossible for investors to earn risk adjusted returns higher than the market return since arbitrage opportunities are impossible (Maysami *et al.*, 2005). However, Moolman and Du Toit (2005) suggest that investors are able to earn higher risk adjusted returns only in the short run because the intrinsic value of stocks in different industries or sectors may be non-uniformly affected by macroeconomic changes. Hence in such cases, the EMH in its strictest form may not hold. There are instances when the EMH did not hold, for example, the 1987 stock market crash when the Dow Jones Industrial Average (DJIA) fell by over 20% in a single day, as evidence that stock prices can seriously deviate from their fair values (Kitatia *et al.*, 2015). In addition, Warren Buffett has consistently beaten the market over long periods which by definition is impossible according to the EMH (Kitatia *et al.*, 2015).

The EMH is anchored on the three crucial assumptions that are investors are assumed to be rational and value securities based on maximum expected utility, investors are not rational, their trades are assumed to be random, offsetting any effect on prices and rational arbitragers are assumed to eliminate any influence irrational investors have on market/security prices. (Copeland and Weston, 1988).

According to Fama (1970) the EMH postulates three forms of market efficiency, namely: weak- form, semi-strong form and strong-form.

#### 2.1.2.1 Weak-Form EMH

The weak-form EMH is consistent with the random walk hypothesis i.e. stock prices move randomly, and price changes are independent of each other, meaning past rates of return provide no indication of future returns (Maysami *et al.*, 2005). It asserts that all historical market prices and data, such as past dividends, asset prices and trading volume, are fully reflected in asset prices (Goodspeed, 2017).

The implication of this is that technical/trend analysis (analysts accurately predicting future price changes through charts of past price movements of stocks) will not be able to consistently produce excess returns, though some forms of fundamental analysis may still provide excess returns (Goodspeed, 2017)

Empirically, Magnusson and Wydick (2002) and Jefferis and Smith (2005), found the JSE to be weak-form efficient using the runs test and random walk tests. Conversely, Appiah-Kusi and Menyah (2003) found that the JSE is not weak-form efficient during periods prior to 1995, but that stock indices revert to weak-form efficiency subsequent to the year 2000.

#### 2.1.2.2 Semi-Strong EMH

The semi-strong form EMH incorporates the weak-form EMH in that it states that all publicly available information is fully incorporated into asset prices (Goodspeed, 2017). Public information includes not only information about an asset’s historical price, but also all information related to the company's performance and future prospects, as well as publicly available analysis or projections regarding macroeconomic factors, policies of the central banks, political news, economic trends, announcements of acquisitions and dividend pay-outs (Goodspeed, 2017). The implication of this is that neither technical nor fundamental analysis

can be used to produce excess returns (Goodspeed, 2017). An investor cannot benefit over and above the market by trading on new information.

Empirically, Ball and Brown (1968) used three classes of data, i.e., contents of income reports, dates of report announcement and security price movements around announcement dates of 261 larger firms. Results revealed that only 10-15% of the information regarding annual earnings announcement has been anticipated. Scholes (1969) examined the impact of new issues of stock and large secondary offerings of common stock on security prices. The results showed that the market on average has fully adjusted to the information and followed a random pattern as corporate insiders needed to report to the Security and Exchange Commission within six days of sale.

#### 2.1.2.3 Strong-Form EMH

The strong-form EMH asserts that all information, public and private, is fully reflected in asset prices (Goodspeed, 2017). Given the assumption that stock prices reflect all information (public and private) the implication of this is that even insider information cannot be used to beat the market or profit above the average as no single investor has monopolistic access to information (Maysami *et al*., 2005).

Empirically, Jensen (1968) used the Sharpe and Lintner model of equilibrium expected return and analysed the returns of 115 mutual funds for a time period of 10 years (1955-1964). As a proxy/norm of market portfolio, Standard & Poor's 500 index was employed. The results empirically inferred that regardless of the fact that fund managers, specialists and market insiders have a wide range of business and financial contacts, no group has access to the private information, and they cannot anticipate the future returns.

The EMH has important implications for both policymakers, government, investors and the stock-broking industry. If it holds true, policy makers may feel free to conduct national macroeconomic policies without the fear of influencing capital formation and the stock trade process (Arnes, 2014). As for the effect of macroeconomic variables such as interest rates, inflation and the exchange rate on stock prices, the efficient market hypothesis suggests that competition among the profit-maximizing investors in an efficient market will ensure that all the relevant information currently known about changes in macroeconomic variables are fully reflected in current stock prices, so that investors will not be able to earn abnormal profit through prediction of the future stock market movements (Maysami *et al.,* 2005)

The EMH in all its forms has shortcomings since the central idea of the EMH is that of a perfectly competitive stock market. However, the stock market is not perfect since it is susceptible to systematic risks like changes in macroeconomic variables and investors can earn profits by correctly predicting the influence of these macroeconomic variables on the stock market. Hence, more realistic and rigorous models have been developed, such as Multifactor Asset Pricing Models (APT and ICAPM).

### 2.1.3 Multifactor Asset Pricing Models

One of the more important developments in modern capital market theory is the Capital Asset Pricing Model (CAPM). It became widely popular mainly for its simplicity of analysing the relationship between systematic risk and expected return for assets. However, this simplicity also resulted in a lot of criticism warning that relying on a single factor (market index) might not incorporate all the asset's risk. Thus, multifactor models such as the Intertemporal Capital Asset Pricing Model (ICAPM) by Merton (1973) and the Arbitrage Pricing Theory (APT) by Ross (1976), were developed to deal with the shortcomings of the CAPM. Multifactor models were developed to incorporate several systematic risk or factors that might affect asset prices or return.

#### 2.1.3.1 Arbitrage Pricing Theory (APT)

Arbitrage pricing theory (APT) formulated by Ross (1976) states that assets' expected returns are based on a number of systemic risk factors (Joshi, 2015). According to Paavola (2006), the APT shows risk in two forms. The first is the risk associated with macroeconomic factors affecting all securities. This is a pervasive risk (systematic risk) and cannot be diversified away by choosing different security classes (Paavola, 2006). The second source of risk is that risk which is unique to each security or sector, as well as being non-systemic in nature (Paavola, 2006). This risk can be diversified away through portfolio diversification.

Several assumptions hold for the APT namely no transaction costs, enough securities to diversify away unsystematic risks, no arbitrage opportunities and equity markets are competitive (Owino, 2014).

The APT model with multiple risk factors is expressed mathematically as follows (Erdugan, 2012):

$$R_i = E(R_i) + b_{i1}F_1 + b_{i2}F_2 + \cdots + b_{ik}F_k + \varepsilon_t \quad (1)$$

Where:

$R_i$ denotes the random rate of return on the $i^{th}$ asset

$E(R_i)$ denotes the expected rate of return on the $i^{th}$ asset

$b_{ik}$ denotes the sensitivity of the $i^{th}$ asset's return to the factor

$F_k$ denotes the $k^{th}$ factor (systematic risk) that affects the returns on equities

$\varepsilon_t$ is a white noise error term (unsystematic risk factors)

Equation 1 expresses the rate of return on equity security as a linear function of multiple factors including macroeconomic variables (systematic risks).

Empirically, Arewa *et al.*, (2013) used the APT to explain the relationship between macro-economic variables and stock market returns. Arewa, *et al*. (2013) in a study of the Nigerian stock market, found overwhelming evidence in support of the APT pricing model as a good description of expected return.

The APT model has its advantages comparing it with CAPM. APT is less restrictive in its assumptions. It allows for an explanatory (as opposed to statistical) model of asset returns (Rasiah and Kim, 2011). It assumes that each investor will hold a unique portfolio with its own particular array of betas, as opposed to the identical "market" portfolio like in CAPM (Rasiah and Kim, 2011). APT explanatory power is potentially better since it is a multifactor model (Joshi, 2015). However, the APT model has its shortfalls, like it lacks theoretical guidance for the selection of the appropriate set of macroeconomic variables to be included in the APT model and it does not state the number of risk factors that should be included in the model (Azeez and Yonoezawa, 2003). The APT also presents certain methodological issues relating to the estimation of the model, namely, as Cheng (1996) points out, it may be sensitive to the number of independent variables included in the linear regression (Günsel and Çukur, 2007).

In terms of this study, one can see how a change in a given macroeconomic variable could be seen as reflecting a change in an underlying systematic risk factor influencing future returns (Humpe and Macmillan, 2009). For instance, a decrease in interest rates, will decrease the borrowing cost, thus firms will borrow more, hence increasing future earnings of the firm and

its share price. With the use of the APT framework, Chen *et al*. (1986) conclude that in choosing macroeconomic variables a model should include factors that impact future cash flows and discount rates and thus incorporate risk that may be either systemic or unique to capital assets (Junkin, 2011). Hence, the selection of a specific macroeconomic variable as a risk factor should be based on economic theory (Chen *et al.*, 1986).

#### 2.1.3.2 Intertemporal Capital Asset Pricing Model (ICAPM)

Merton (1973) developed the Intertemporal Capital Asset Pricing Model (ICAPM). It is a linear factor model where the wealth and factors or state variables forecasts changes in the distribution of future returns and income (Raei *et al.*, 2011). In addition, holding periods are allowed to change through time (Humpe, 2008). Intertemporal refers to investment opportunities over time, hence investors use the ICAPM model for solving the long-term decisions while they are facing an uncertain future (Raei *et al.*, 2011). The notion of the model is to find variables or factors that are relevant to the performance of investors' portfolios (Humpe, 2008). These factors or variables can be macroeconomic variables which can influence returns or income (Erdugan, 2012).

Merton (1973) developed an intertemporal asset pricing model in which the changes in the investment opportunities (uncertainties) affect future asset returns, which in turn affect consumption (Humpe, 2008). For instance, consumption is related to the money supply, inflation, GDP and other macro-economic variables. Those macro variables can therefore, measure the state of the economy or in line with this thesis it measures the state of the stock market. Merton showed that investors will take into account not only their wealth, but also the uncertainty of the future economy in their current investment decisions (Rasiah and Kim, 2011). This suggests that they will hedge against possible economic shocks that are likely to reduce the expected utility of their consumption (Rasiah and Kim, 2011).

ICAPM assumptions are as follows: all assets have limited liability, no transaction costs and taxes, no dividends are paid, all assets are infinitely divisible, and investors believe that their decisions do not influence the market price (Krause, 2001). Additionally, all trades take place in equilibrium, there are unrestricted borrowing and lending of all assets at the same conditions, trading takes place continuously, uncertainty cannot be eliminated by a continuous revision of the portfolio, the state variables follow a joint Markov process and the state variables change continuously (Krause, 2001).

One can see how ICAPM model applies to this study as it suggests changes in macroeconomic events (change in interest rates by the central bank) will cause changes in the distribution of future returns of various indices on the stock market. Hence investors will want to use their portfolios to hedge against such changes.

According to Rasiah and Kim (2011) the major implication of the model is that multiple betas are needed to explain expected return; and that the number of the betas equal one (i.e. the broad market factor) plus additional state variables which affect investors' investment opportunities and consumption preferences (and hence their expected utility) over time (Merton 1973).

Merton (1973) developed the ICAPM using utility maximization to get exact multifactor predictions of expected security returns. Fama (1996) built Merton's ICAPM on similar intuition. The ICAPM risk return relation is a natural generalization of the CAPM. It addsrisk premiums for the sensitivities of Ri to the returns, Rs, s=1,…,S, on the (economic) state-variable related portfolios. The ICAPM has the following form:

$$R_{it} - r_t = \alpha_i \beta_i (R_{mt} - r_t) + \sum^{s}{}_{s=1} \beta_{is} (R_{st} - r_t) + u_{it} \quad (2)$$

where, $\beta_i$ and $\beta_{is}$, are the slopes from the multiple regression of $R_i$ and $R_m$ and $R_s$. From equation (2) assets are exposed to market risk and risk of changes in market conditions (risk of changes in macroeconomic variables (Lo and Wang, 2006). Hence investors wish to hold two distinct portfolios of the risky market portfolio and a hedging portfolio (Lo and Wang, 2006). The market portfolio allows investors to adjust their exposure to market risk and the hedging portfolio allows them to hedge the risk of changes in market conditions (Lo and Wang, 2006).

The ICAPM model has its advantages as it allows additional state variables and hence is a better model than CAPM. ICAPM imposes very loose restrictions on the pricing factors. However, the model has its shortfalls for. ICAPM assumes no transaction costs, no taxes and these assumptions are not fully applicable to real-world investing. ICAPM is the continuous model with a pretty loose restriction on state variables, it is hard to apply to the discrete cross-sectional data (Kwon and Sohn, 2018).

In terms of empirical evidence, Maio (2008) used the ICAPM model to evaluate three factors, future cash flow perspective, equity and the prospects of the bonds future perspectives. The results showed that the I-CAPM predicted better conditions of future investment portfolio than the Fama and French (1996) three factor model. Unlike, the Fama and French model, the

ICAPM model can estimate unusual trends facing the risk premium. Gerard and Wu (2006) used a simple ICAPM to analyse the statistical and economic relevance of intertemporal risk in explaining the dynamics of the premium for holding stocks and bonds. They tested a conditional asset pricing model that includes long-term interest rate risk as a priced factor for four asset classes: large stocks, small stocks, and long-term Treasury and corporate bonds. They found that the interest risk premium is the main component of the risk premiums for bond portfolios but represents only a small fraction of the total risk premiums for equities. This suggests that stocks, especially small stocks, are hedges against variations in the investment opportunity set. They also found that, at average market volatility levels, investors earn annual premiums between 3.6% during expansions and 5.8% during recessions for bearing intertemporal risk.

### 2.1.4 ICAPM versus APT

ICAPM and APT models both lack theoretical guidance for the selection of the appropriate set of macroeconomic variables to be included in the models and it does not state the number of risk factors that should be included in the model (Krause, 2001). If all portfolios are perfectly diversified and the state variables equal the common factors, the ICAPM collapses to the APT (Lo and Wang, 2006). Therefore, APT can be viewed as a special case of the ICAPM. As a result, the APT and ICAPM are often treated alike, despite their different theoretical foundations (Lo and Wang, 2006).

### 2.1.5 Present Value Model (PVM)/Discounted Cash Flow Models (DCF)

DCF models relate share prices to future expected cash flows (Humpe and Macmillan, 2009). The models assert that the current value of a firm (and therefore its share price) is a reflection of a firm's expected future cash flows (dividends), as well as the future discount rate of these cash flows (Humpe and Macmillan, 2009). The advantage of the DCF model is that it can be used to focus on the long run relationship between the share market and macroeconomic variables (Humpe and Macmillan, 2009). These variables influence expected profit and therefore the future expected cash flows (dividends) that are the principal factor determining share price valuation. Consequently, the DCF model presents a solid foundation linking share prices and the macroeconomy. This is shown in the equation below as followed by Banda (2017):

$$P_0 = \sum_{t=0}^{\infty} \frac{D_t}{(1+k_e)^t} \quad (3)$$

Where:

$P_0$ is the current value of a share,

$D_t$ is the dividend at time t

$k_e$ is the required rate of return on common equity.

Equation (3) shows that the present value of the asset $P_0$ is equal to the sum of the expected future cash flows (dividends), as well as the future discount rate of these cash flows. Hence from the equation above a change in factors influencing the required rate of return will affect future cash flows or dividend streams of the capital asset, thus altering its present value.

In terms of this paper the PVM provides a firm theoretical grounding for linking the macroeconomic variables and stock prices (Ahmed, 2008). For instance, a rise in short term interest rates (macroeconomic variable) influences dividends mainly through the firm's current and expected earnings. A rise in interest rates causes a decrease in capital investments and, therefore, a reduction in the firm's sales and thereby a decrease in its earnings. Thus, if discount rates are affected by economic factors (or if future dividend payments are affected by these factors) it can be concluded that these macroeconomic variables must have an influence also on the pricing of market securities.

The disadvantage of the DCF model is that it assumes that the dividend payments are fixed especially in the long run, which is unrealistic due to the cyclicality of expected profits (Olalere, 2006). There are other dividend models like Gordon Growth Model (GGM), Multi-Staged Gordon Growth Model, H-Model and Three-Stage Gordon Growth Model, which can overcome the deficiencies of the PMV by allowing future dividend payments to change.

### 2.1.6 Conclusion

From the information above the most appropriate model to follow for this thesis will the APT model since the paper will be looking at the linkages between various systematic factors or non-diversifiable macroeconomic variables and sub sector indices. Hence the APT model will express the rate of return of the various stock indices as a function of multiple factors or systematic risks or macroeconomic variables. The changes in the systematic risks are the source

of impact on expected earnings, dividend and the discount rate which affect the returns of the stock. Therefore, the thesis will be following the APT approach, along with previous studies such as Chen and Jin (2004), Paavola (2006), Benakovic and Posedel (2010) and Putranto *et al*., (2014).

## 2.2 Empirical Literature

### 2.2.1 Introduction

Several studies have examined the relationship between macroeconomic variables and the JSE All Share Index. These studies either examined the impact of just domestic factors or included a combination of domestic and international variables. Few studies expanded the scope of analysis by looking beyond the All Share Index (ALSI) to include a few sectoral sub-indices to test whether the relationships change on a sectoral basis. Previous empirical evidences related to the relationship of the selected macroeconomic variables and share returns in an international as well as South African context are discussed below. In addition a summary of the international and South Africa (Aggregate and Sub-sectors) literature review are shown in Appendices 2.1-2.6.

### 2.2.2 Developed Countries (Aggregate Indices)

Studies on the relationship between domestic macroeconomic variables and the aggregate stock market index include Avgerinopoulou (2018) analysed the relationship between the stock market prices of FTSE 100 index and various macroeconomic factors in United Kingdom using monthly data for the period 2002-2016. Jareño and Negrut (2016) investigated the relationship between the US stock market (Dow Jones and S&P500 indices) and some relevant US macroeconomic factors. Talla (2013) conducted a research on the impact of macroeconomic variables on the stock market prices of the Stockholm Stock Exchange (OMXS30). Using monthly data from 1993-2012. Ratanapakorn and Sharma (2007) investigated the short-run and long-run, as well as causal, dynamics between US stock returns (S&P 500) and various macroeconomic variables using monthly data from 1975:1 to 1994:4.

Although, Masuduzzaman (2012), Hsing and Hsieh (2012), Humpe and Macmillan (2009) and Nasseh and Strauss (2000) also looked at the relationship between domestic macroeconomic variables and the ALSI, in addition they investigated on the importance of international macroeconomic variables. Masuduzzaman (2012) investigated the long-runrelationship and

the short-run dynamics among macroeconomic fundamentals and the stock returns of Germany and the United Kingdom from February 1999 to January 2011. Humpe and Macmillan (2009) make a comparative applied analysis for US and Japan by investigating the relationship between macroeconomic variables and stock market movements. Monthly data from January 1960 to June 2004 is used to conduct the analysis. The aggregate stock variables under consideration are the S&P 500 and Nikkei 225 price index for US and Japan respectively. Hsing and Hsieh (2012) analysed the relationship between macroeconomic variables and Poland Stock Exchange. Nasseh and Strauss (2000) examined long-run relationship between stock prices and domestic and international economic activity in for France (industrial (INSEE) share price index), Germany (all share price index) Italy (MSE share price index), Netherlands (all share price index), Switzer-land (all share price index) and the UK (FT 500 share price) index. Quarterly data from 1962.1 to 1995.4 was used.

The empirical results of the above researchers are sometimes contradictory as shown in following summary of their findings.

#### 2.2.2.1 Inflation

The general assumption is that the relationship between inflation and returns on stock markets is ambiguous and can be either negative or positive. This is confirmed by various authors finding contradictory results. Talla (2013) showed a significant negative relationship with Stockholm Stock Exchange (OMXS 30). Hsing and Hsieh (2012) found a negative relationship with the Poland Stock Market. Humpe and Macmillan (2009) inferred a negative significant relationship between S&P 500 and inflation, while, Ratanapakorn and Sharma (2007) showed a positive long run relationship with S&P 500. Masuduzzaman (2012) found that inflation was positively related to the German Stock Market (DAX 30) but negatively related to FTSE 100. Nasseh and Strauss (2000) found that the stock prices in France, Germany, Italy, Netherlands, Switzerland and UK are positively related to domestic consumer price index. Jareño and Negrut (2016) inferred an insignificant relationship with US stock market

#### 2.2.2.2 Exchange rate

Theoretically, there should be a negative relationship between exchange rate and stock markets because depreciation in an import-oriented country (like South Africa) result in a negative impact on stock prices since an increase in the cost of imports leads to lower cash flows available for spending in domestic industries and a subsequent fall in stock prices. Talla (2013)

showed a significantly negative relationship between the exchange rate and the Stockholm Stock Exchange. Hsing and Hsieh (2012) found a negative relationship with the Poland Stock Market. Contrary to the general assumption, Avgerinopoulou (2018) results showed a significantly positive impact of the exchange rate (Pound/ Euro) and the FTSE 100. Ratanapakorn and Sharma (2007) results also show a positive long run relationship between exchange rate and S&P 500.

#### 2.2.2.3 Interest rate

Theory suggest there is a negative relationship between interest rate and stock markets. Higher interest rates raise the cost of borrowing for firms and thereby reduce future earnings. They also raise the discount rate against which future dividends are measured today. However, various authors found contradictory results. Avgerinopoulou (2018) showed a negative but insignificant relationship between FTSE 100 index and Treasury bills. Jareño and Negrut (2016) inferred a negative significant relationship between long term interest rate and US stock market (Dow Jones and S&P 500 indices). Talla (2013) found a negative insignificant relationship between interest rate and Stockholm Stock Exchange. Hsing and Hsieh, (2012) showed a negative relationship between Poland stock market. Ratanapakorn and Sharma (2007) found a negative long run relationship between long term interest rate and the S&P 500. However, a positive long run relationship with the short-term interest rate was observed.

Masuduzzaman (2012) likewise found a negative relationship between FTSE 100 and Treasury bill rates (represent interest rate for UK) but the bond rate (representing interest rate for Germany) was positively related to DAX 30. Humpe and Macmillan (2009) showed negative significant relationship between S&P 500 and 10-year Treasury-Bond yield, but that the Nikkei 225 revealed a positive (but insignificant) relationship to Japanese discount rate. Nasseh and Strauss (2000) found domestic short term interest rate and international short-term interest rates to be positively related to the stock markets (France, Germany, Italy, Netherlands and UK), except for Switzerland Stock Exchange which was insignificant to international short term interest rates but significant to domestic interest rates. However, local and international long term interest rates were negatively related to stock markets. However, Switzerland Stock Exchange which was insignificant

The findings also indicate that there are both short and long run causal relationships between stock prices and interest rates.

#### 2.2.2.4 Economic Activity or Growth (proxy of GDP)

While there is little research on using the coincident indicator as a proxy for GDP growth as is done in this thesis, a number of other proxies for economic growth like industrial production as well as GDP itself have been used in the literature to determine the link between changes in domestic economic activity and stock markets. A positive relationship between economic growth and stock markets is expected as a growing economy creates new opportunities for firms to increase sales and profits.

Avgerinopoulou (2018) observed a positive significant relationship between industrial production and FTSE 100 index. In addition, the author found a positive and significant relationship with GDP. Jareño and Negrut (2016) showed a positive relationship between US stocks (Dow Jones and S&P500 indices), industrial production and GDP. Hsing and Hsieh, (2012) found a positive relationship between GDP, industrial production and Poland Stock Market and Ratanapakorn and Sharma (2007) showed a positive long run relationship between S&P 500 and industrial production.

Masuduzzaman (2012) found a positive short and long run causal relationships between industrial production and FTSE 100 and DAX 30 and Humpe and Macmillan (2009) found a positive and significant relationship S&P 500, Nikkei 225 price index and industrial production. Nasseh and Strauss (2000) showed a positive significant relationship between domestic and international macroeconomic activity (industrial production) and stock prices (France, Germany, Italy, Netherlands, Switzerland and UK). In addition, the results showed industrial production is a significant factor in explaining long run movement in stock prices.

#### 2.2.2.5 Money Supply

Theory suggests that the relationship between money supply and stock markets can be either positive or negative. Increases in the money supply may be the result of strong private sector credit growth and therefore rising corporate profits and share prices. However, rising money supply may signal future interest rate hikes that will have a negative impact for profits and share prices. Talla (2003) found money supply to be positively insignificantly related to OMXS 30. Ratanapakorn and Sharma's (2007) study showed a positive relationship between

money supply and S&P 500. Masuduzzaman (2012) found a negative relationship between money supply and FTSE 100. However, it was positively related to DAX 30. The findings also indicate that there are both short and long run causal relationships between stock prices and money supply. Humpe and Macmillan (2009) showed that money supply has no significant impact on S&P 500, but is negatively and significantly related to Nikkei 225 price index.

#### 2.2.2.6 International factors

The study of Nasseh and Strauss (2000) revealed a long run relationship between stock prices in France, Germany, Italy, Netherlands, Switzerland and UK and overall macroeconomic activity in Europe.

### 2.2.3 Developed Countries (Sub Sector Indices)

A small number of studies have been done on the relationship between domestic macroeconomic variables (inflation, money supply, exchange rate, economic growth and interest rate) and various sector indices of stock markets. Çiftçi (2014) investigated the influence of four macroeconomic variables: crude oil, interest rate, exchange rate and gold, on stock returns of ten U.S. industries from January 1997 to September 2014. Zhu (2012) analysed the impact of macroeconomic factors on the energy sector of the Shanghai stock market (SEE) from January 2005 to December 2011. Maysami *et al.* (2005) investigated the influence of the macroeconomy on the Singapore stock market at an aggregate level and sector level. Study on the relationship between domestic and international macroeconomic variables and the various sector indices include Gunsel and Cukur (2007) who performed a sectoral study on the effects of macroeconomic factors on the London Stock returns.

The findings of these studies are outlined below.

#### 2.2.3.1 Inflation

Zhu (2012) found inflation rate insignificantly and positively related to return of energy sector in Shanghai stock market. Maysami *et al*. (2005) showed a positive relationship between inflation and the Singapore stock market at an aggregate level and sector level (Singapore All Share Index, Finance Index, Property Index). However, inflation was significantly and negatively related to the Hotel Index. Gunsel and Cukur (2007) inferred that unexpected

inflation was found to have a significant and negative effect on the food, beverage and tobacco sectors.

#### 2.2.3.2 Exchange rate

Zhu (2012) found exchange rate to be significantly and positively related to returns of the energy sector in Shanghai stock market. However, Maysami *et al*. (2005) found a positive relationship between exchange rate and Singapore stock market at an aggregate level and sector level (Singapore All Share Index, Finance Index, Property Index). However, exchange rate was negatively and significantly related to the Hotel Index. Gunsel and Cukur 's (2007) results showed that the real effective exchange rate had a significant and positive effect on the chemical sector, but a negative and significant effect on the building materials and merchants, and engineering sectors. Ciftci (2014) found a positive relationship between Basic Materials, Consumer Goods, Technology and Telecommunications Indices.

#### 2.2.3.3 Interest rate

Gunsel and Cukur (2007) showed that one- month-lagged-term structure[1] of interest rate was found to have a positive and significant relationship with the construction, food, beverage and tobacco, oil exploration and production and electronic and electrical equipment sectors. Çiftçi (2014) found insignificant relationship between Basic Materials, Consumer Goods, Consumer Services, Financials, Health Care, Industrials, Oil and Gas, Technology, Telecommunications and Utilities Indices and short term interest rate in all study periods. Maysami *et al*. (2005) results revealed a negative relationship between Singapore All Share Index, Finance Index, Property Index and one year interbank rates. However, Hotel Index was insignificant. Also, Maysami *et al*. (2005) found a positive relationship between Singapore All Share Index, Finance Index, Property Index and three months interbank offer rate. However, Hotel Index was insignificant

#### 2.2.3.4 Economic Activity or Growth (proxy of GDP)

Zhu (2012) found industrial production to be insignificantly but positively related to returns of the energy sector in the Shanghai stock market. Maysami *et al*. (2005) showed a positive relationship between industrial production and Singapore stock market at an aggregate level

[1] Term structure refers to the yields-to-maturity of bonds that exhibit different terms to maturity but are similar in other respects, particularly with regard to default risk (Van Rensburg, 1995).

and sector level (Singapore All Share Index, Hotel index, Property Index). Gunsel and Cukur (2007) found that unanticipated sectoral industrial production had a negative and significant effect on the food, beverage and tobacco and engineering industries.

#### 2.2.3.5 Money Supply

Zhu (2012) found money supply insignificantly but positively related to returns of the energy sector in Shanghai stock market. Maysami *et al.'s* (2005) study revealed a positive relationship between money supply and Singapore stock market at an aggregate level and sector level (Singapore All Share Index, Finance Index and Property Index). However, money supply was negatively and significantly related to the Hotel Index. Gunsel and Cukur (2007) found that money supply had a positive and significant effect on the building materials and merchants, as well as the food, beverage & tobacco sectors while a negative relationship was found with household goods and textiles.

### 2.2.4 Developing Countries (Aggregate Indices)

Studies on the relationship between domestic macroeconomic variables and just the All Share index in developing countries include Dasgupta (2012) who attempted to explore the long-run and short-run relationships between BSE SENSEX and four key macroeconomic variables of the Indian economy. Khalid and Khan (2017) investigated the effects of interest rates, exchange rates and inflation rates on Karachi Stock Exchange Index or the KSE-100 Index of Pakistan using annual time series data from 1991-2017 periods. Rafay *et al.* (2014) also examined for slightly different time periods the relationship between various macroeconomic variables and KSE 100 index (Karachi Stock Exchange). Naik and Padhi (2012) investigated the effect of macroeconomic variables on the Indian stock market index (Sensex)

Sohail and Hussain (2009), Hsing (2011), Tangjitprom (2011) and Büyükşalvarcı (2010) looked at the relationship between domestic macroeconomic variables and not just the ALSI, but in addition investigated international macroeconomic variables. Sohail and Hussain (2009) examined long-run and short-run relationships between Lahore Stock Exchange and macroeconomic variables in Pakistan. Hsing (2011) compares the Czech stock market with US and German stock markets. Tangjitprom (2011) examined the importance of macroeconomic factors in the performance of Thailand stock market. Büyükşalvarcı (2010) examined seven macroeconomic factors on European region specifically Turkish stock market (Istanbul stock

exchange). Ozbay (2009) and Yurdakul and Akcoraoglu (2005) also explored the long-run relationship between some macroeconomic factors and the Istanbul Stock Exchange.

Empirical evidence on domestic macroeconomic variables and All Share Indices in African countries (excluding SA) include Adam and Tweneboah (2008), Kuwornu and Owusu-Nantwi (2011) and Ibrahim and Musah (2014) who investigated the effects of macroeconomic variables on stock market returns in Ghana. Abraham (2011) and Abdulrahim (2011) examined the relationship between selected macroeconomic variables and the Nigerian and All Share Index, while Makatchaya (2014) does likewise for the Malawi Stock Exchange.

Empirical evidence on both domestic and international macroeconomic variables and ALSI for African countries (excluding SA) include Kitati *et al.* (2015), Adesanmi (2018), Acquah (2014), Kirui *et al.* (2014), Songole (2012), Ozbay (2009), and Yurdakul and Akcoraoglu (2005). Kitati *et al.*(2015) examined the influence of the selected macro-economic variables on companies listed on the Nairobi Securities Exchange in Kenya. Adesanmi (2018) analysed the impact of both national and global macroeconomic factors on MINT countries (Mexico, Indonesia, Nigeria and Turkey). Acquah (2016) investigated the dynamic interrelationships among stock prices and selected macroeconomic indicators in Ghana. Kirui *et al.* (2014) and Songole (2012) investigated the relationship between selected macroeconomic variables and stock return on the Nairobi Securities Exchange (NSE All Share Index).

The empirical results of the above researchers are sometimes contradictory as shown below.

#### 2.2.4.1 Inflation

Sohail and Hussain (2009)'s showed a negative long run (significant) relationship between Lahore Stock Exchange and inflation. Dasgupta (2012) showed only negative significant long run relationship between wholesale price index (proxy for inflation) and Indian Stock Exchange (BSE SENSEX). Naik and Padhi (2012) indicated Sensex (Indian Stock Exchange) to be negatively and significantly related to inflation. Hsing (2011) found a negative significant relationship between inflation and Czech stock market. However, Ibrahim and Musah (2014) also found a significant positive long run relationship between CPI and Ghana Stock Exchange. Tangjitprom, (2011) found no significant relationship between inflation rate and the Thailand stock exchange. Also, a study by Rafay *et al.* (2014) showed no relationship with KSE 100 index. Ozbay (2009) infered an insignificant positive relationship between inflation (Consumer Price

Index and Producer Price Index) and Istanbul Stock Exchange National 30 Index (ISE 30 National Index).

For African countries Khalid and Khan (2017) found a long run relationship to be positive (significant) with KSE 100 Index. Adam and Tweneboah (2008) found a significant negative relationship between inflation and Ghanaian Stock Exchange, both in short and long run. Abraham (2011) revealed an insignificant between Nigerian All Share Index and inflation. Ibrahim and Musah's (2014) results infered a significant positive long run relationship with the Ghanaian Stock Exchange. Kitati *et al.* (2015) found a negative relationship between inflation and companies quoted on the Nairobi Securities Exchange. However, Kirui *et al.*'s (2014) results indicated that inflation is insignificantly related to the Nairobi Securities Exchange (NSE- 20 Index).

#### 2.2.4.2 Exchange rate

Hsing (2011) found a negative significant relationship between exchange rate and Czech stock market. Dasgupta (2012) empirical results showed negative significant long run relationship between exchange rate and Indian Stock Exchange (BSE SENSEX). Tangjitprom (2011) results revealed a negative relationship with Thailand Stock Exchange. Yurdakul and Akcoraogle (2005) and Buyuksalvarci (2010) found a negative relationship with Istanbul Stock Exchange. However, Sohail and Hussain (2009) found positive long run relationship with the Lahore Stock Exchange. The study by Khalid and Khan (2017) indicated that no relationship between exchange rate and the market index. Also, Rafay *et al.* (2014) results show no relationship with KSE 100 index.

The study on other African countries by Adam and Tweneboah (2008) revealed a significant positive long run and negative short run relationship between exchange rate and Ghanaian Stock Exchange. Abraham (2011) revealed a positive relationship between the stock market and exchange rate in the long run but not significant in the short run. Makatchaya (2014) results showed a depreciation of the exchange rate has a positive impact on Malawian Stock Exchange. Kirui *et al.* (2014) found a positive relationship with Nairobi Securities Exchange. However, Adesanmi (2018) revealed a positive long run relationship between exchange rate and Nigerian All Share Index. However, Ibrahim and Musah (2014) infered a significant negative short-run and long-run relationship between Ghanaian Stock Exchange All Share Index and exchange rate. Kitati *et al.* (2015) and Songole (2012) found a negative relationship between Nairobi

Stock Exchange and foreign exchange rate. Abdulrahim (2011) found no relationship with Nigerian Stock Exchange. Also, Kuwornu and Owusu - Nantwi (2012) empirical results showed that there no relationship between exchange rate and Ghanaian Stock Exchange All Share Index.

#### 2.2.4.3 Interest rate

Dasgupta (2012) showed a significant positive long run relationship between call money market and Indian Stock Exchange (BSE SENSEX). Firat (2013) results revealed a positive relationship with BIST 100 index. However, Buyuksalvarci (2010) found a negative relationship with Istanbul Stock Exchange. Khalid and Khan (2017) found interest rate being significantly and negatively (short and long run) related to market index. Hsing (2011) found a significant negative relationship between real interest rate, euro area government bond yield and Czech stock market. Ozbay (2009) infered a negative significant relationship between interest rate (Treasury bills and Overnight Interest Rate) and Istanbul Stock Exchange National 30 Index (ISE 30 National Index). Tangjitprom, (2011) showed a significantly negative to the Thailand stock exchange. Adesanmi (2018) indicated a negative short but positive long–run relationship between interest rate and stock returns in Turkey. Rafay *et al.* (2014) showed no relationship with KSE 100 index. Naik and Padhi (2012) found Sensex (Bombay Stock Exchange) to be negatively but insignificantly related to the Indian three months government treasury bills.

The study on other African countries by Adesanmi(2018) found positive long run relationship between interest rate and Nigerian All Share Index. Adam and Tweneboah (2008) found a positive long run significant, but, negative short run relationship between treasury bills and Ghanaian Stock Exchange. Kuwornu (2012) empirical results showed a significant positive relationship between short term (Treasury bills) and Ghanaian Stock Exchange All Share Index in the short and long run. However,Kyereboah-Coleman and Agyire-Tettey(2008) showed that lending rates is negatively related to Ghanaian Stock Exchange All Share Index and tend to smother the growth of businesses in Ghana. Abraham's(2011)study revealed that a significant negative short run relationship exists between the stock market and the minimum rediscounting rate (MRR) while its long run component is insignificant. Makatchaya (2013) results showed a negative impact between interest rate and Malawian Stock Exchange. Abdulrahim (2011) results showed a negative relationship between short term interest rate and Nigerian Stock Exchange. Kitati *et al* (2015) found a significant negative relationship between interest

rate and companies quoted on the Nairobi Securities Exchange. Acquah (2016) results revealed a negative relationship with Ghanaian Stock Exchange. Songole (2012) found a negative relationship between market interest rate and Nairobi Stock Exchange.

Kirui *et al* (2014) results showed that treasury bills are negatively but insignificantly related to Nairobi Securities Exchange (NSE-20 Index). Ibrahim and Musah (2014) infered a insignificant short-run and long-run relationship between Ghanaian Stock Exchange All Share Index and interest rate.

#### 2.2.4.4 Economic Activity or Growth (proxy of GDP)

Yurdakul and Akcoraoglu (2005) results revealed a positive long run relationship between Istanbul Stock Exchange and real economic activity. Sohail and Hussain (2009) found a significant positive long run relationship between Lahore Stock Exchange (LSE25 index) and industrial production index. Dasgupta (2012) and Naik and Padhi (2012) empirical results showed both a positive significant long run relationship between industrial production index and Indian Stock Exchange. Firat (2013) found a negative relationship with BIST 100 index. Hsing (2011) found a positive relationship between real GDP and Czech stock market. However, Büyükşalvarcı (2010) found a negative relationship between industrial production and Istanbul Stock Exchange Index. Adesanmi (2018) study revealed a negative short-run relationship between industrial production and Turkey stock returns. Ozbay (2009) found an insignificant relationship.

The study on other African countries by Ibrahim and Musah (2014) indicated a significant negative long-run relationship between Ghanaian Stock Exchange All Share Index and industrial production. However, Acquah (2016) inferred a positive relationship between economic activity and Ghanaian Stock Exchange. Songole (2012) results revealed a positive relationship between industrial production index and Nairobi Stock Exchange. Adesanmi (2018) found insignificant short run relationship but positive long run relationship with the Nigerian Stock Exchange. However, Abdulrahim (2011) showed a positive but insignificant relationship between industrial production and Nigerian Stock Exchange. Kirui *et al.* (2014) results showed that GDP is positively but insignificantly related Nairobi Securities Exchange (NSE-20 Index).

#### 2.2.4.5 Money Supply

The study by Sohail and Hussain (2009) found a significant positive long run relationship between Lahore Stock Exchange (LSE25 index) and money supply. Buyuksalvarci (2010) results revealed a positive relationship with Istanbul Stock Exchange. Naik and Padhi (2012) found Sensex (Bombay Stock Exchange) to have a significant positive long run relationship. Yurdakul and Akcoraoglu (2005) found a positive long run relationship between Turkey Stock Exchange and money supply. Ozbay (2009) found an insignificant positive relationship between money supply (M1, M2, M2Y and Central Bank Money) and Istanbul Stock Exchange National 30 Index (ISE 30 National Index).

The study on other African countries Ibrahim and Musah (2014) revealed a significant long-run positive relationship between Ghanaian Stock Exchange All Share Index and money supply. Abdulrahim's (2011) results showed a significant positive relationship between money supply and Nigerian Stock Exchange.

### 2.2.5 Developing Countries (Sub-sectors)

A small number of studies expanded the scope of analysis by looking not just at the All Share Index (ALSI) but also a number of its sectoral sub-indices and their relationship with domestic and international macroeconomic variables, to investigate if the relationships change on a sectoral basis. Studies on the relationship between just domestic macroeconomic variables and the various sector indices (excluding other African countries) include Al-Shubiri (2010) who analysed the movement of the stock prices as the consequence of the movement of the micro and macroeconomic factors. The sample of study includes the 14 commercial banks of Amman Stock Exchange for the period 2005 -2008. Ozcan (2012) examined the relationship between macroeconomic variables and Istanbul Stock Exchange (ISE) industry index from 2003 to 2010. Saeed (2012) examines the impact of macroeconomic variables on various sector returns by applying multifactor model within an APT frame work. Ihsan *et al.* (2007) analysed the relationship of economic and financial variables with ten industrial sector indices of KSE using monthly data from July 1985 to July 2002. Jambotkarl and AnjanaRaju (2018) investigated the relationship between macroeconomic variables and various Indian sector indices.

Empirical evidence on the relationship between domestic and international macroeconomic variables and the various sector indices (excluding other African countries) include Saeed (2012) who investigates the impact of macroeconomic factors on sectoral returns by applying

multifactor model within an APT framework. Arnes (2014) investigated whether it is possible to predict stock market returns on the Istanbul Stock Exchange (XU100 National index) and various sector indices with the use of macroeconomic variables using monthly data from 1994 to 2013.

Studies between domestic macroeconomic variables and sectorial sub-indices in (African countries) include Okech and Mugambi (2016) who explored the impact of macroeconomic variables on stock returns of listed banks on the Nairobi Securities Exchange (NSE) from 2000 to 2015. Gatuhi (2015) analyzes the effect of macroeconomic environment on stock market returns of firms in the Agricultural Sector in Kenya. Garba (2014) examined the impact of macroeconomic factors on common stock returns of the manufacturing firms listed on the Nigerian Stock Exchange from 1991 to 2003 and Izedonmi and Abdullahi (2011) empirically tested the monthly performance of the Arbitrage Pricing Theory (APT) in the Nigerian Stock Exchange (Industry/Sector) for the period 2000 to 2004.

Owino (2014) examined the short-run and long-run effects of domestic and European Union's macroeconomic variables on the Nairobi Securities Exchange's 20-share index for 1993 to 2013.

The empirical results of the above studies reveal different (but sometimes contradictory) relationship between macroeconomic variable and different listed sectors as shown in the following sections.

#### 2.2.5.1 Inflation rate

Studies on other African countries by Okech and Mugambi (2016) revealed that the inflation rate is positively and significant related to the stock returns of listed banks in the Nairobi Securities Exchange. However, Gatuhi (2015) results showed a negative influence of inflation on an Agricultural Index in Kenya. However, Garba (2014) inferred a negatively but insignificant relationship with stock returns of the manufacturing firms listed on the Nigerian Stock Exchange, but, Izedonmi and Abdullahi (2011) found positive but insignificant relationship with Nigerian (Industrial Sector).

Studies on other developing countries (excluding Africa) by Ihsan et al. (2007) found a negative relationship with cotton and textile, chemicals and pharmaceutical, paper and board, cement, transport and communication and banks and other financial institutions sectors.

Jambotkarl and AnjanaRaju (2018) results revealed a negative relationship between Nifty Financial service and Private bank indices and inflation, however, a positive relationship with Nifty Energy. Al-Shubiri (2010) found a negative relationship between inflation and 14 listed commercial banks in Amman Stock Exchange.

#### 2.2.5.2 Exchange rate

Okech and Mugambi (2016) found that the exchange rate is significantly negatively related to the stock returns of listed banks in the Nairobi Securities Exchange. Gatuhi *et al.* (2015) results showed a positive influence on Agricultural sector in Kenya. Garba (2014) found an insignificant negative relationship with stock returns of Nigerian manufacturing firms listed on the Nigerian Stock Exchange, but, Izedonmi and Abdullahi (2011) revealed a positive but also insignificant relationship with Nigerian (Industry Sector).

Saeed (2012) found negative relationship between exchange rate and automobiles and cable and electronics in Pakistan. However, the study revealed a negative but insignificant relationship with the returns of glass and ceramics, leasing, cement, jute, oil and gas sector and chemical and pharmaceutical. In addition, exchange rate has a positive significant relationship with the returns of the textile composite index. Ihsan *et al.* (2007) revealed a negative relationship between exchange rate and Pakistan's cotton and textile, sugar and allied, fuel and energy and banks and other financial institutions sectors. Jambotkarl and AnjanaRaju (2018) found a negative between exchange rate and Nifty Auto, Bank, IT, Financial service, PSU Bank, FMCG, Private bank and Pharma indices, however, Nifty Energy Index was positive. Arnes (2014) results revealed a negative relationship between Financial Index, Technology Index, Industrials Index and nominal exchange rate, however, Services Index is negatively related to both nominal and real effective exchange rate.

Ozcan (2012) found exchange rate and Istanbul industry index to exhibit a long run equilibrium relationship.

#### 2.2.5.3 Interest rate

Okech and Mugambi (2016) found interest rate is being negatively and significantly related to the stock returns of listed banks in the Nairobi Securities Exchange. Gatuhi (2015)'s showed a positive influence on Agricultural sector in Kenya and Garba (2014) found a negative insignificant relationship with stock returns of the manufacturing firms listed on the Nigeria.

Owino (2014) found a negative relationship between Kenya's 91 T-bill rate and NSE's 20 share index.

Al-Shubiri (2010) found a negative but insignificant relationship between lending interest rate and 14 commercial banks of Amman Stock Exchange. Saeed (2012) shows that short term interest rate has a negative and significant impact on Karachi Stock Exchange different sectors (textile composite, cement, cable and electrical goods, automobile, chemical and pharmaceutical, leasing and glass and ceramics) except jute and oil and gas sector. Ozcan (2012) found interest rate and Istanbul (ISE) industry index exhibit a long run equilibrium relationship. Jambotkarl and AnjanaRaju (2018) results revealed a negative relationship with Nifty Auto index. Ihsan *et al.* (2007) found a negative relationship between interest rate and chemicals and pharmaceutical, fuel and energy and banks and other financial institutions sectors. Arnes (2014) results revealed a negative relationship with Turkey Technology Index.

#### 2.2.5.4 Economic Activity or Growth (proxy of GDP)

Studies on other African countries like Okech and Mugambi (2016) found GDP to be negatively but insignificantly related to the stock returns of listed banks in the Nairobi Securities Exchange. Owino (2014) results revealed a positive relationship between NSE's 20 Share Index and industrial production in both long and short run.

Research by Al-Shubiri (2010) revealed a significant positive significant relationship between GDP and 14 commercial banks of Amman Stock Exchange. Saeed (2012) found an insignificant Jute and cement, oil and gas sector, textile composite, automobile, cable and electronics leasing, glass and ceramics and chemical and pharmaceutical sectors. Ihsan *et al.* (2007) found a negative relationship between GDP and cotton and textile, fuel and energy, transport and communication and banks and other financial institutions sectors.

#### 2.2.5.5 Money Supply

Gatuhi (2015) showed a positive influence of money supply on Kenya Agricultural's sector. Owino (2014) results revealed a positive relationship between NSE's 20 share index and EU's money supply.

Saeed (2012) showed that there is a insignificant relationship between money supply and oil and gas, textile, composite, jute, cement, cable and electrical goods, automobile, chemical and

pharmaceutical, leasing and glass and ceramics indices in Pakistan. Ozcan (2012) found money supply and Istanbul industry index to exhibit a long run equilibrium relationship.

### 2.2.6 South Africa (Aggregate Indices)

Several studies have examined the relationship between macroeconomic variables and the South African stock market. These studies usually examined the impact of just domestic factors, but some included a combination of domestic and international variables. A small number of studies expanded the scope of analysis by looking not just at the JSE All Share Index (ALSI) but also a number of its sectoral sub-indices, including mining index, construction index, pharmaceutical index, retail index, to see whether the relationships with macroeconomic variables change on a sectoral basis.

Studies on the relationship between just domestic macroeconomic variables and the JSE ALSI include Coetzee (2002) who used monetary variables to test for a relationship between various macroeconomic variables and JSE (ALSI) index from 1991 to 2001. Beukes (2009) analysed the link between certain macroeconomic variables and share prices on the JSE (ALSI) using quarterly data series from the first quarter of 2000 to the second quarter of 2008, while, Ndlovu *et al.* (2018) used quarterly data from 1981 Q1 to 2016 Q4. Muchaonyerwa and Choga (2015) specified a business cycle model with the business cycle coincident indicator of South Africa being the independent variable explained by the All Share Price index (ALSI). Ntshangase *et al*. (2016) examined the relationship between the ALSI and macroeconomic variables for the period 1994 to 2012. Moores-Pitt and Strydom (2017) and Moores-Pitt (2018) examined only the relationship between JSE equity returns and inflation.

In addition to looking at the relationship between domestic macroeconomic variable and the ALSI like the above authors, Coovadia (2014), Olalere (2006) and Jefferis and Okeahalam (2000) investigated the impact of also international macroeconomic variables. Coovadia (2014) examined the long-term equilibrium relationship between domestic and international macroeconomic variables and the Johannesburg Stock Exchange (JSE) using quarterly data from 1994 to 2012 and Olalere (2006) from 1990 to 2004. Jefferis and Okeahalam (2000) analyses the impact of economic fundamentals on stock markets in southern Africa using quarterly data from 1985 to 1995 for South Africa and Zimbabwe and from 1989 to 1996 for Botswana.

The empirical results of the above researchers are described in the following sections.

#### 2.2.6.1 Inflation

Ntshangase *et al.* (2016), Beukes (2009), Olalere (2006) and Coetzee (2002) found a negative relationship between inflation and JSE All Share Index. Coetzee's (2002) study revealed this negative relationship in both the short and long term. Ntshangase *et al.* (2016) results showed positive relationship in the long run, but, a negative relationship in the short run. However, Moores-Pitt (2018), Ndlovu *et al.* (2018), Moores-Pitt and Strydom (2017), Muchaonyerwa and Choga (2015) and Coovadia (2014) found a positive relationship between inflation and the stock market. Ndlovu *et al.* (2018) study revealed, a positive relationship in the long run, however insignificant in the short run. Coovadia (2014) reveled a positive relationship both in the short and long run.

Findings on the relationship between inflation and share prices in South Africa are therefore contradictory. This is not surprising as the theory in this area is unclear. On the one hand share prices and other real assets may be a hedge against inflation. On the other hand, rising inflation may damage GDP growth and bring about higher interest rates which will be negative for company earnings and share prices.

#### 2.2.6.2 Exchange rate

Studies of the impact of the exchange rate on SA stock prices are also contradictory. Coetzee (2002), Ntshangase *et al.* (2016) and Ndlovu *et al.* (2018) revealed a negative relationship between the exchange rate and the JSE All Share Index, but the results of Jefferis and Okeahalam (2000), Muchaonyerwa and Choga (2015) indicated a positive relationship. Olaleres (2006) found the exchange rate had little or no influence on the JSE All Share price Index but become negative and significant with the JSE All Share Index market capitalization. Ntshangase *et al.* (2016) study revealed negative relationship in the long run however the short run is insignificant. Ndlovu *et al.* (2018) found a negative relationship in the long run, but, a positive relationship in the short run. Coetzee (2002) results revealed a negative relationship between exchange rate and JSE All Share Index in the long and short run.

#### 2.2.6.3 Interest rate

Ntshangase *et al.* (2016), Coetzee (2002), Jefferis and Okeahalam (2000) and Muchaonyerwa and Choga (2015) found a negative relationship between interest rate and the stock market, however Beukes (2009) and Ndlovu *et al.* (2018) found a positive relationship. Coovadia

(2014) found a positive relationship between short term interest rate and the stock market. Ndlovu *et al.* (2018) found a positive relationship both in the short and long run. Coetzee (2002) study revealed a negative relationship between interest rates and All Share Index both in the long and short run. Coovadia (2014) found a positive relationship between short term interest rate and the stock market in the short run. Jefferis and Okeahalam (2000) found a negative relationship between domestic, foreign interest rates and JSE All Share Index, both in the long and short run. Ntshangase *et al.* (2016) found a negative relationship between interest rate and JSE All Share Index in the long run.

In terms of the relationship between stock market and international macroeconomic variables Olalere (2006) revealed that United States government bonds has a negative significant impact on JSE All Share price Index, but produce a positive significant impact on JSE All Share Index market capitalization. The study showed that United States interest rate is more important than the domestic interest rate in explaining the share price and market capitalization on the JSE.

#### 2.2.6.4 Economic Activity or Growth (proxy for GDP)

Studies by Jefferis and Okeahalam (2000) and Coovadia (2014) showed that there is a positive relationship between the ALSI and gross domestic product growth. Muchaonyerwa and Choga (2015) found a positive relationship between the ALSI and the business cycle, but in their study the business cycle was the dependent variable. Contrary to *a priori* expectations, Coetzee (2002) and Ndlovu *et al.* (2018) found the relationship to be negative. However, Olalere (2006) found the relationship between domestic GDP, US GDP and JSE All Share Index insignificant. Coovadia (2014) and Jefferis and Okeahalam (2000) results revealed a positive relationship between GDP and JSE All Share Index in both the long and short run.

#### 2.2.6.5 Money Supply

The relationship between money supply and the ALSI is found to be negative by Coovadia (2014) and Ntshangase *et al.* (2016) in the long run, but positive in the short run. Ndlovu *et al.* (2018) results revealed a positive relationship in the long run. Muchaonyerwa and Choga (2015) found a positive relationship.

### 2.2.7 South Africa (Sub Sector Indices)

Studies on the relationship between just domestic macroeconomic variables and the various JSE indices include Hackland (2016), who used quarterly data from 2005-2014 to assess the relationship between various macroeconomic variables with the Top 40, Resource 10, Industrial 25 and the Financial 15 FTSE/JSE indices. Gupta and Reid (2013), explored the sensitivity of industry-specific stock returns to monetary policy and macroeconomic news from May 2002 to January 2011. Hancocks (2010), investigated the extent to which inflation, long and short-term interest rates, money supply and exchange rates (Rand/US) influence stock market prices on the All-Share, Financial, Mining and Retail Indices of the Johannesburg Stock Exchange from 1996:7 to 2008:12. Banda (2017), investigated the causal relationships (long run and short run) between the Industrial Index 25 and gross domestic product (GDP), inflation (CPI), prime rates and exchange rates. Quarterly data from 1995 Q3 to 2015 Q2. Afordofe (2011), examined the link (correlation) between GDP, inflation, interest rates and the Rand/US Dollar Exchange Rate and the Resource Index of the JSE for period 2002 to 2011. Banda (2017) investigated the causal relationships (long run and short run) between the JSE Industrial Index 25 (INDI 25) and gross domestic product (GDP), inflation (CPI), prime rates and exchange rates.

In addition to domestic macroeconomics variables, Van Rensburg (1995) and Junkin (2011) also investigated the impact of international macroeconomic variables effect on various stock indices. Van Rensburg (1995), estimated the simultaneous relationship between a number of selected macroeconomic variables and share prices on the Johannesburg Stock Exchange (JSE) and various sub-sectors over the period 01/01/1980 to 31/12/1989. Junkin (2011), investigated whether FTSE/JSE All Share Index, construction and materials, financial, food producers', general retailers, industrial, mining and pharmaceuticals indices are influenced by macroeconomic variables using monthly data for the period 1995 to 2010.

The results of these studies which at times are contradictory are discussed in the following sections.

#### 2.2.7.1 Inflation

Findings on the relationship between inflation and various sector indices gave contradictory results, similar to aggregate index.

Hackland (2016) found inflation to be negatively correlated with Top 40 and Resource 10 index. Gupta and Reid (2013) found ALSI, Top 40, mining, financial and industries, basic industrials, resources and retailer indexes were insignificantly related to inflation, only Gold Mining Index was negatively related. The results of Hancocks (2010) showed a negative and significant long run effect of inflation on both the ALSI and Financial sector. According to Junkin (2011), All Share Index, Construction and materials, Financial and Pharmaceutical indices are impacted negatively. Van Rensburg (1995) results showed unanticipated changes in inflation are significantly negatively related to the JSE All Share, All-Gold, Mining-Financial and Financial and Industrial indices.

Hancocks (2010), observed a positive effect on the retail sector and Junkin (2011) found that inflation impacted the Industrial and General Retail indexes positively. Banda's (2017) study revealed that inflation significantly increases stock price of the Industrial 25.

Van Rensburg (1995) and Gupta and Reid (2013) infered a negative relationship between the mining index and inflation. The studies by Hancocks (2010), Junkin (2011) and Van Rensburg (1995) found a negative relationship between JSE All Share and inflation and Hancock's (2010) and Junkin's (2011) studies showed a negative relationship between financial index and inflation. Unlike all the other authors, Afordofe (2011) found the relationship between inflation and resource index to be inconclusive.

#### 2.2.7.2 Exchange rate

Banda (2017) showed a insignificant effect of exchange rate on the Industrial 25. Adordofe (2011) found a positive relationship between the exchange rate and resource share returns. Hancocks (2010) also found a positive and significant influence on the retail and mining sectors. However, Hancocks (2010) revealed that the JSE All Share Index and Financial Index are negatively related to the exchange rate, however, Mining Index and Retail Index are positively related. Hackland (2016) found a negative correlation with Top 40, Industrial 25 and Financial 15 indices. Junkin (2011) results revealed a positive relationship between All Share Index, Mining Index and exchange rate, however, negative relationship was found on Construction and Material Index, Food Producers Index and General Retail Index.

#### 2.2.7.3 Interest rate

Hackland (2016) revealed a negative correlation of the Prime lending rate and JSE Top 40, Resource 10 and Financial 15 indices. Gupta and Reid (2013) observe that JSE ALSI, Top 40, financial, financial and industries, general industrials, gold mining, basic industrials, resources and retail sectors are negatively related to the repo rate. Hancocks (2010) found that All-Share, Financial, Mining and Retail indices are negative influenced by short term interest rates, however only Mining and Retail indices are significant.

Banda (2017) found a negative relationship between the prime rate and industrial 25 in the long run. Afordofe (2011) observed a negative correlation between interest rates and resource share returns. Van Rensburg's (1995) results indicated that term structure of interest rates is significantly negatively related to JSE All Share, All-Gold, Mining-Financial, Financial and Industrial indices.

Hancocks (2010) found a positive effect of long term rates on both the mining and retail sectors, however, a negative relationship with financial sector.

#### 2.2.7.4 Economic Activity or Growth (proxy of GDP)

The relationship between GDP and the various sectors of the JSE is found to be positive by Hackland (2016) and Afordofe (2011). However, the results of Banda (2017) found no relationship.

Hackland (2016) found a positive relationship between GDP and Industrial 25 and Financial 15 indexes. Gupta and Reid (2013) showed a insignificant relationship between GDP and the financial index, the ALSI, Top 40, financial and industries, general industrials, gold mining, basic industries, mining, and retail sectors. Junkin (2011) results revealed domestic industrial production is negatively related to Financial Index and Pharmaceutical Index, however, it is positively related to General Retail Index, Industrial Index, Mining Index and Food Producers Index. Junkin (2011) also results revealed that US GDP is negatively related to Construction and Material Index, Financial Index, Food Producers Index, General Retail Index, Mining Index, however, positively related to the Pharmaceutical Index.

#### 2.2.7.5 Money Supply

Empirical evidence from Hancocks (2010) showed a positive and significant effect of money supply on all indices (All Share, Financial and Mining indices) except Retail Index which the variable is restricted upon.

#### 2.2.7.6 International variables

In term of international macroeconomic variables, Junkin (2011) found a positive relationship between pharmaceutical index and US GDP, but a negative relationship between US GDP and the JSE All Share index, construction and materials, financial, food producers', general retailers, industrial and mining indexes. Van Renburg (1995) found a positive and significant relationship between the Dow-Jones industrial index and the JSE All Share Index, All-Gold, Mining-Financial, Financial and Industrial indices and Dow-Jones industrial index.

### 2.2.8 Conclusion

The empirical evidence on the nexus between macroeconomic variables and broad share market indices is abundant, locally and internationally. However, in terms of the relationship between macroeconomic variables and various sector indices the literature review is limited, especially on the South African context. In addition, the relationship between the macroeconomic variables and the share returns were not always consistent with *a priori* expectations from economic theory.

# CHAPTER 3: THE BEHAVIOUR OF JSE ALL SHARE INDEX AND VARIOUS SECTOR INDICES IN SOUTH AFRICA

Individual graphs of the JSE indices and macroeconomic variables used in this study are shown in Appendices 3.1 and 3.2, respectively.

## 3.1 The relationship between short- term interest rate and various JSE indices

Figure 1 graphically shows the relationship between short term interest rate and various JSE indices from June 1995 to December 2018.

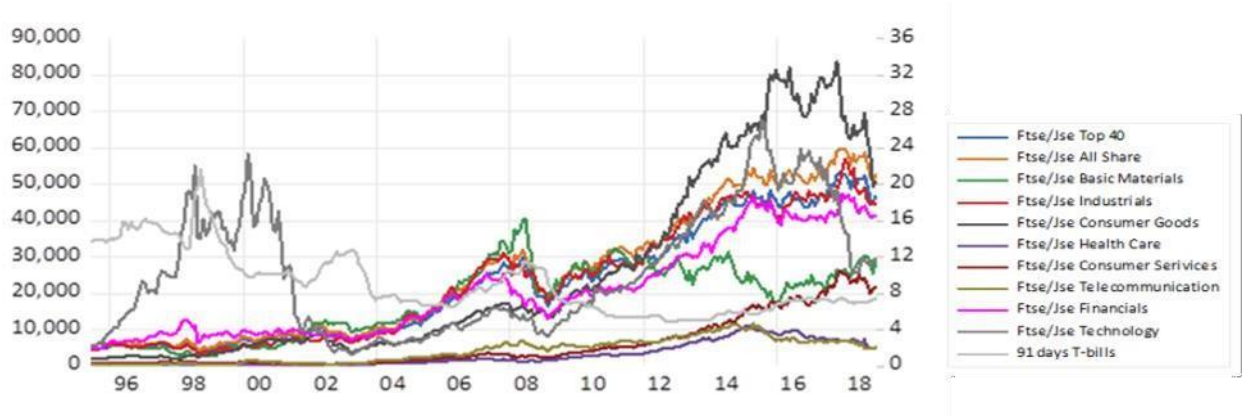


*Figure 1: Short term interest rate vs various indices*
*(INET BFA, 2019)*

Figure 1 shows that in 1997-1998 the turbulence in Southeast Asian financial markets affected global financial markets including South African financial markets. The Asian crisis instigated an increase in the interest rates by the SARB in order to protect the South African economy from further global economic fallout and this is accompanied by a fall in the various stock indices prices. During 2001–2002 the bursting of the global "Dot com" bubble and US "War on Terror" caused SARB to tighten their monetary policy again to insulate the domestic economy, again causing the stock markets to perform poorly. In 2008, the global financial crisis hit the economy and as noted in the diagram above there was a drastic decrease in the various indices returns. The SARB had to ease the monetary policy (decrease interest rates) in order to stimulate economic growth. Generally short term interest rate have been decreasing over the time period as shown in Figure 1. Overall the results show a negative relationship between short term interest rates and various stock indices.

### 3.2 The relationship between coincident indicator and various JSE indices

Figure 2 shows coincident indicator and various JSE indices behaviour in South Africa from June 1995 to December 2008.

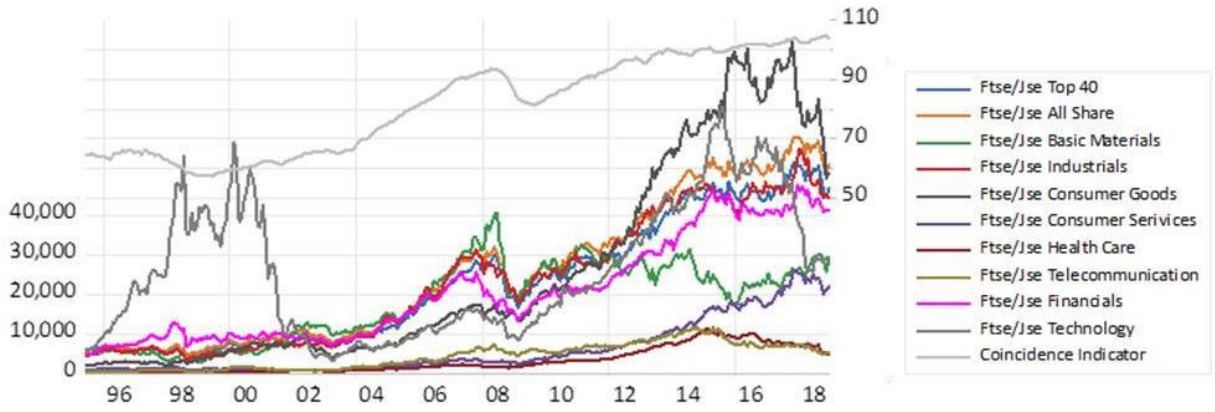


*Figure 2: Coincident Indicator vs various indices*
*(INET BFA, 2019)*

Figure 2 shows that coincident indicator (proxy for GDP) has been increasing gradually and the major reason is the substantial inflow of foreign capital since the ending of apartheid, the lifting of sanctions in 1994 and strong rise in the output of the non-agricultural sectors of the economy. In 1998 and again in 2008 the coincident indicator decreased due to the Asian and global financial crises, respectively. Hence, economic activity in the country decreased, in both periods causing all various sector indices (except FTSE/JSE Health Care) index to decrease in 2008. Most of the indices were affected due to liquidity and solvency problems in the financial sector. The coincident indicator has been increasing gradually after the crisis. Overall there seems to be a positive relationship between the coincident indicator and the various indices.

### 3.3 The relationship between inflation and various JSE indices

Figure 3 demonstrates the relationship between inflation and various JSE indices in South Africa for June 1995 to December 2008.

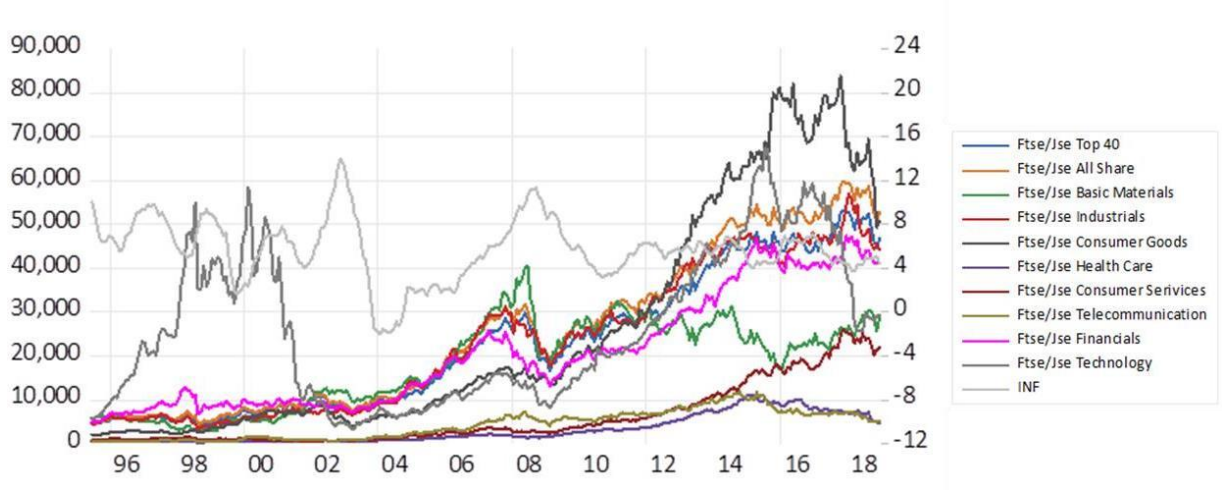


*Figure 3: Inflation vs various indices*
*(INET BFA, 2019)*

Figure 3 shows that inflation in 1995 decreased. This was due to a decrease in prices of imported goods and food products like meat, fresh fruits and vegetables (SARB, 1995). In 1996-1997 the inflation rate increased due to depreciation of the rand, persistent strong growth in the money supply and domestic credit extension and rising food prices (SARB, 1996). The period 2001-2002 shows a sharp increase in the CPI which was caused by depreciation in the exchange rate of the rand towards the end of 2001 and a rise in the prices of imported petroleum and increase in food prices instigated by the severe drought in the southern African region (SARB, 2001). In 2003 there was drastic drop in inflation due to sustained application of prudent monetary and fiscal policies and production prices of imported goods started to decline (SARB, 2003). Price inflation in the domestic economy accelerated between 2004 and 2008 as a consequence of increase in international crude oil prices, rising food price inflation and sustained strong consumer demand (SARB, 2005). In 2008-2010 there was drastic decrease in the general prices due to fallout from the financial market turmoil which aggravated the slowdown in world economic growth and commodity prices fell back significantly. After 2010 inflation fluctuated but at very stable rate. Overall inflation is much more volatile than the various stock indices and it is difficult to determine the relationship between the variables.

### 3.4 The relationship between real effective exchange rate and various JSE indices

Figure 4 presents the relationship between real effective exchange rate and various JSE indices behaviour in South Africa from June 1995 to December 2008.


*Figure 4: Real Effective Exchange Rate vs various indices (INET BFA, 2019)*

Figure 4 shows that in 1995 the real effective exchange rate strengthened due to the positive 1994 democratic elections, lifting of the economic sanctions and access to foreign capital. Drastic decline in the real effective exchange rate in 1996 was caused by the rand becoming target of speculative attacks (SARB, 1996). The real effective exchange rate weakened in 1998 as a result of the Asian crisis but recovered and was stable from 1998-2000, due to renewed investor confidence in emerging markets, non-resident investors substantially increasing their holdings of South African debt and equity securities and improved competitiveness of South African producers in foreign markets. The Dot Com bubble and terrorist attacks during September 2001 in the United States heightened volatility in the market causing the real effective exchange rate to depreciate, sharply, but by 2007 it had more than recovered previous losses. In 2008 the exchange rate also depreciated due to the global financial crisis. It again recovered its losses but has been steadily depreciating since 2010. From the diagram the relationship between the exchange rate and the various stock indices is unclear. At time like after the 1998 and 2001 crises the relationship is positive. At others, like the period of steady weakening since 2010 it has been positive.

## 3.5 Conclusion

Changes in the macroeconomic variables shown in the diagrams above appear to have either positive or negative impacts on the various sectors of JSE. For some variables the relationship is unclear. Understanding the relationship between these variables can help investors, government and banks hedge their risk.

# CHAPTER 4: RESEARCH METHODOLOGY AND DATA

## 4.1 Introduction

This chapter presents the framework used by the study for the analysis of the relationship between macroeconomic variables and various sector indices on the JSE. Aspects of the framework covered include the research paradigm, model specification, theoretical framework, econometric techniques utilised in the analysis, definition of variables and *a priori* expectations, data description and sources and diagnostic tests.

## 4.2 Research Paradigm

Understanding the research paradigm is essential to research as it helps researchers create knowledge based on credible research foundations. Valid research adheres to some underlying philosophical assumptions and in order to conduct and evaluate any research it is therefore important to know, understand and correctly apply these assumptions. This section discusses the philosophical assumptions underpinning this research study.

There are three major philosophical assumptions namely interpretivism/constructivist paradigm, critical theory paradigm and positivism paradigm (Kivunja and Kuyini, 2017). Paradigm is a belief, pattern, frame of reference, structure or system of academic and scientific research and methodologies, assumptions and values for observation and understanding (Creswell *et al.*, 2007 and Rubin and Babbie, 2010). The choice of research paradigm is influenced by the context of the researcher in terms of the researcher and the research environment and factors related to the characteristics of the research problem (Kivunja and Kuyini, 2017).

The positivist paradigm is based on the philosophical idea of Auguste Comte. The paradigm asserts that scientific knowledge is the only means to reveal the truth about reality (Pham, 2018). This truth is acquired through observations and experience (Pham, 2018). It relies on logic and theory as a way of interpreting sensory experience (Pham, 2018). It aims to provide explanations and to make predictions based on measurable outcomes (Kivunja and Kuyini, 2017). Comte postulated that experimentation, observation and reason based on experience ought to be the basis for understanding human behaviour, and therefore, the only legitimate means of extending knowledge and human understanding (Kivunja and Kuyini, 2017). The research located in this paradigm relies on quantifiable observations, statistical analysis, logical

analysis after empirical observations, formulation of hypotheses, testing those hypotheses, to derive conclusions (Pham, 2018). High quality standard of validity and reliability are elements provided by positivist researchers (Kivunja and Kuyini, 2017).

The information provided above links with this paper in the sense that this thesis analyses the relationship between macroeconomic variables and various stock market sector indices based on empirical evidence and theoretical review. To this end, quantifiable data has to be collected (secondary data), and hypotheses tested using statistical analysis. In this analysis ARDL will be employed to provide logical analysis and predictions based on measurable outcomes and conclusions. Hence, this paper will be following the positivist paradigm.

## 4.3 Research Design

This section looks at the model specification, theoretical framework, the definition of the interdependent and dependent variables and *a priori* expectations.

### 4.3.1 Model Specification and Theoretical Framework

In order to analyse the long and short run relationship between macroeconomic variables and the various sub-sector indices, this paper will revisit the model by Chen *et al.* (1986) and studies by Hancocks (2010) and Junkin (2011), with modification in terms of the macroeconomic variables and sectoral indices used to depict stock market performance. The empirical technique used also differs from Hancocks (2010) and Junkin (2011), Ibrahim and Musah (2014), Ajayi and Olaniyan (2016) and Banda (2017) in that the autoregressive distributed lag (ARDL) cointegration approach or bound testing method is used as opposed to Johansen cointegration approach. To account for structural breaks three dummy variables will also be employed. Dummy 1 represents the Asian crisis. Dummy 2 represents Dot Com crisis. Dummy 3 represents 2007 financial crisis.[2]

In addition to looking at the relationship for the overall time period, June 1995 to December 2018[3], this paper will also look at two separate sub periods, June 1995 to June 2007 sub period (pre global financial crisis) and July 2007 to December 2018 sub period (post financial crisis).

[2] Even thou for this paper only 3 crises are employed however many crises have occurred between 1995-2018 namely 1998 Russian financial crisis, 1999-2002 Argentine economic crisis, 2015 Chinese stock market crisis, just to name a few.

[3] The full period employed in this paper is from June 1995 to December 2018 because all the indices data started from June 1995 hence in order to have consistence, all the variables collected are from 1995.

This is, to see if any changes to the relationship between the macroeconomic variables and various indices have occurred the aftermath of the 2007 financial crisis.

The choice of macroeconomic variables is guided by theoretical factors that might influence share valuations through changes in either expected future dividends or the discount rate in line with the APT model as well as the use of variables in the literature. The sectoral models will all have the same explanatory macroeconomic variables, but the endogenous variable (the JSE sectoral index) for each model will be different.

In order to investigate the relationship between the selected macroeconomic variables and the performance of the various indices, Chen *et al.* (1986) multivariate regression model is adopted with modified macroeconomic variables and various sectors. This study estimates the following regression:

$$Y_t = \beta_1 + \beta_2 CI_t + \beta_3 INF_t + \beta_4 ST_t + \beta_5 REER_t + \beta_6 D_1 + \beta_7 D_2 + \beta_8 D_3 + \varepsilon_t \quad (4)^4$$

Where:

$Y_t$= dependent variables namely JSE All Share Index, JSE Top 40 Index, JSE Basic Materials Index, JSE Consumer Goods Index, JSE Consumer Services Index, JSE Financials Index, JSE Health Care Index, JSE Industrials Index, JSE Technology Index and JSE Telecommunications Index

$\beta$ = coefficient of the variable

$CI_t$, $INF_t$, $ST_t$, and $REER_t$= coincident indicator, inflation, short term interest rate and real effective exchange rate, respectively.

[4] It is important to note that even though long term interest rate and money supply are included in the literature review, they are not included in the regression. This is because the focus is on including only those variables most commonly used in the literature. Moreover, long term interest rates are not included because they are geometric averages of current and expected future short term interest rates (Faure, 2017). Hence, including both short and long term rates is unlikely to add significant new information. Short term rates are chosen because under inflation targeting the South African Reserve Bank focuses on changing short term rates to meet the inflation target. In addition, under inflation targeting money supply is the endogenous outcome of changes in interest rates and credit demand and so is also not included.

Oil and Gas Index data from INET BFA was inconsistent hence it would have produced inaccurate results if it was included in this paper.

They are no data for Utilities Index data yet hence it was not included in this paper.

$D_1$= Asian crisis dummy such that $D_1$=1 for t=July1997-May 1998 and $D_1$=0 for otherwise.

$D_2$= Dot Com crisis dummy such that $D_2$=1 for t=March 2000-October 2002 and $D_2$=0 for otherwise.

$D_3$= 2007 Financial crisis dummy such that $D_3$=1 for t=July 2007-May 2009 and $D_3$=0 for otherwise.

$\varepsilon_t$= error term

To reduce multi-collinearity, obtain efficient results and avoid non-sense regression this paper will convert the basic linear model into a semi-log form (Banda, 2017). The semi- log form is as follows:

$$InY_t = \beta_1 + \beta_2 InCI_t + \beta_3 INF_t + \beta_4 ST_t + \beta_5 InREER_t + \beta_6 D_1 + \beta_7 D_2 + \beta_8 D_3 + \varepsilon_t \quad (5)$$

Where:

$InY_t$ = log of dependent variables, namely JSE All Share Index, JSE Top 40 Index, JSE Basic Materials Index, JSE Consumer Goods Index, JSE Consumer Services Index, JSE Financials Index, JSE Health Care Index, JSE Industrials Index, JSE Technology Index and JSE Telecommunications Index.

$InCI_t$ =log of coincident indicator

$InREER_t$= log of real effective exchange rate

It is important to note that from equation 5 the study does not take the natural logs of inflation and short term interest rate because these are expressed as a percentage. However, real effective exchange and coincident indicator are expressed as natural logs because they are indices.

### 4.3.2 Definition of Variables

#### 4.3.2.1 Dependent Variable

The dependent variable will be the various sectoral stock market indices of the JSE. Stock market indices are carefully computed as the monthly closing prices of the various indices. Changes in the levels of the various indices will be used as a measure of sectoral stock market performance. The indices used are as follows:

#### 4.3.2.1.1 JSE All-Share Index

The All-Share Index is constructed as a market capitalisation-weighted index and is used to measure the movement of the overall JSE equity market. It represents 99% of the full market capitalisation value of the approximately 160 largest listed companies (Raubenheimer, 2010). This proxy for South African markets has been widely used as a measure of stock market performance in other empirical studies such as those by Jefferis and Okeahalam (2000), Coetzee (2002), Olalere (2006), Beukes (2009), Coovadia (2014), Muchaonyerwa and Choga (2015), Moores-Pitt and Strydom (2017) and Ndlovu *et al.* (2018).

#### 4.3.2.1.2 JSE Top 40 Index

The JSE Top 40 index comprises the 40 largest companies on the JSE weighted by their market capitalization in the FTSE JSE All-Share Index (Beukes, 2009). This proxy has been widely used as an additional measure of stock market performance in other empirical studies of South Africa such as those by Van Rensburg (1995), Junkin (2011), Afordofe (2011), Gupta and Reid (2013) and Hackland (2016).

#### 4.3.2.1.3 JSE Industrials Index

The JSE Industrials Index consists of Construction and Materials, Aerospace and Defence, General Industrials, Electronic and Electrical Equipment, Industrial Engineering, Industrial Transportation and Support Services indices (Industry Classification Benchmark, 2019). This proxy has been used as a measure of stock market performance in other empirical studies such as those by Junkin (2011), Hackland (2016) and Banda (2017).

#### 4.3.2.1.4 JSE Basic Materials Index

The sectoral sub-indices that make up the Basic Materials Index are Chemicals, Forestry and Paper, Mining and Industrial Metals and Mining (Industry Classification Benchmark, 2019). This proxy was used as a measure of stock market performance by Hancocks (2010) and Junkin (2011).

#### 4.3.2.1.5 JSE Financials Index

The JSE Financials Index consists of the sub-indices Banks, Insurance, Real Estate and Financial (Industry Classification Benchmark, 2019). This proxy was used as a measure of stock market performance by Hancocks (2010) and Junkin (2011).

#### 4.3.2.1.6 JSE Consumer Goods Index

The JSE Consumer Goods Index consists of the sub-indices Automobiles and Parts, Food and Beverages and Personal and Household Goods (Industry Classification Benchmark, 2019). As similar proxy was used by Junkin (2011).

#### 4.3.2.1.7 JSE Health Care Index

The JSE Health Care Index consists of the Health Care Equipment and Services and Pharmaceuticals and Biotechnology sub-indices (Industry Classification Benchmark, 2019). Junkin (2011) used the pharmaceutical index as a measure of sectoral stock market performance.

#### 4.3.2.1.8 JSE Technology Index

The JSE Technology Index consist of the Software and Computer Services and the Technology Hardware and Equipment sub-indices (Industry Classification Benchmark, 2019). To the best of this author's knowledge, this index has not been used in previous studies of sectoral stock market performance but a similar proxy was used by Arnes (2014) for Pakistan Technology Index and Ciftci (2014) for US Technology Index.

#### 4.3.2.1.9 JSE Telecommunications Index

The JSE Telecommunications Index consists of the Fixed-line Telecom Services and Mobile/wireless Telecommunications sub-indices (Industry Classification Benchmark, 2019). A similar proxy was used for other countries by Ihsan *et al.* (2007), Türsoy *et al.* (2008), Özlen (2014) and Ciftic (2014).

#### 4.3.2.1.10 JSE Consumer Services Index

The JSE Consumer Services Index consists of the sub-indices Food and Drug Retailers, General Retailers, Media and Travel and Leisure (Industry Classification Benchmark, 2019).

This proxy has been used as a measure of stock market performance in other empirical studies, including Hancocks (2010).

#### 4.3.2.1.11 Independent Variables

The following macroeconomic variables are, according to the theory, expected to impact on stock market performance in the way described.

#### 4.3.2.1.12 Interest Rate

A 3-month Treasury Bill (3 Month T-Bill) will be used as a proxy for short term rate because monetary policy action has a direct and immediate effect on the stock market and short term interest rate changes (Majija, 2017). Studies that have used this proxy are Nasseh and Strauss (2000), Ratanapakorn and Sharma (2007) and Naik and Padhi (2012).

This thesis hypothesises a negative relationship between interest rate and stock price. Low rates are expected to stimulate transfers of funds from the money market to the stock market and high yielding rates are expected to stimulate transfers in the opposite direction (Msindo, 2016). Interest rates determine companies' borrowing costs and so higher rates are likely to impact negatively on cash flows. Low rates are likely to stimulate borrowing for capital expansion and future earnings growth. Hence, a negative relationship between stock prices and the short term interest rate is expected. Also, since the present value of shares is determined by discounting future cash flows to the present time, higher interest rates make the given future cash flows less valuable. This implies that the share price will decline as interest rates rise.

#### 4.3.2.1.13 Coincident Indicator Index (proxy for GDP)

The coincident indicator of the SA Reserve Bank is a weighted average of selected economic indicators which have historically coincided with the business cycle or can be broadly defined as variables that are correlated with the current level of economic activity (Davies and Van Seventer, 2009).

According to SARB Quarterly Bulletin (2015), the composite coincident business cycle indicator consists of the following economic indicators: Gross value added at constant prices, excluding agriculture, forestry and fishing, total formal non-agricultural employment, valueof retail and new vehicle sales at constant prices, industrial production index and utilisation of production capacity in manufacturing

The study employs the coincident indicator as a proxy for domestic economic activity. The reason why the coincident indicator index is used instead of the most commonly used proxies like GDP or industrial production is, firstly, because SA GDP is measured only quarterly. For this research, all variables are monthly data. The alternative of interpolating quarterly to monthly data may not always accurately capture short term changes in a data series and thus the use of interpolated time series data with a trend may yield misleading results (Junkin, 2011). The alternative of industrial production (which is available monthly) is not an appropriate measure of real economic activity in South Africa, because SA industrial production accounts for only a small portion of GDP (Junkin, 2011). It excludes the mining and financial sectors as well as household consumption, which may be more important for stock prices. Hence a composite index is a better proxy of economic growth because it reflects a broader spectrum of the economy, comprising real, monetary, fiscal, and external sector data (Mongardini and Sedik, 2003). Study by Muchaonyerwa and Choga (2015) have also used the coincident indicator index as a proxy of economic activity.

A positive relationship between the coincidence index and the stock market is expected. A rapidly growing economy creates an opportunity for companies to increase their sales and profits and, hence, stock prices are likely to decline. Conversely, weak economic growth may be accompanied by stagnant or falling sales, weaker profit growth and lower share prices.

#### 4.3.2.1.14 Real Effective Exchange Rate

In this study, it is expected that there is a negative relationship between the exchange rate and stock prices. The real effective exchange is the nominal effective exchange rate adjusted for the inflation differential between South Africa and its major trading-partner countries (Motsumi *et al.*, 2008). These major trading partners are Euro area, United States, China, United Kingdom, Japan, Switzerland, Australia, Sweden, just to name a few (Motsumi *et al.*, 2008). Real effective exchange rate of the rand may be regarded as a barometer of external competitiveness in manufacturing (Motsumi *et al.*, 2008). The weights assigned to the selected trading partners reflect the price competition between South African exports and locally produced goods in foreign markets, between imports from the rest of the world and locally produced goods in South Africa, and between South African exports and exports of other countries in third-currency markets (Motsumi *et al*., 2008).

The reason for using the real effective exchange rate is because South Africa is highly dependent on international trade for capital goods and global financial markets for borrowing. Hence, movement in the exchange rate can affect the country's international trade patterns. It is important to note an increase in real effective exchange rate is noted as an appreciation of the real effective exchange rate (Khomo and Aziakpono, 2016).

The impact of exchange rate on stock prices is likely to vary from an export-oriented to an import-oriented country (Nisha, 2015). Under the assumption that South African is an import-oriented country (as justified in Appendix 4.1) depreciation in the exchange rate may result in a negative impact on stock prices since an increase in the cost of imports leads to lower cash flows available for spending in domestic industries and a subsequent fall in stock prices (Nisha, 2015). Alternatively, depreciation in an export-oriented country leads to a positive impact on stock prices because an increase in the volume of exports leads to higher cash flows for the domestic industries followed by a rise in stock prices (Nisha, 2015).

The importance of exports in South Africa is emphasised on the JSE where large mining companies make up a substantial share of market capitalisation. In addition, the importance of "dual-listed" stocks amongst the largest shares by market capitalisation means that these stock prices (which are determined in foreign currency globally, usually in the UK) will automatically adjust when the Rand exchange rate weakens or strengthens. Thus, although theory suggests that the relationship between share prices and the exchange rate can be either positive or negative, for South Africa the relationship is expected to be positive (stronger exchange rate, higher share prices) for import oriented companies and their respective indices and negative for sectoral indices which are export dependent. This variable has also been used in studies such as Muchaonyerwa and Choga (2015) and Korhonen (2015).

#### 4.3.2.1.15 Inflation

This study hypothesises that the relationship between inflation and stock prices can be either negative or positive. Inflation is a general increase in the price level. Inflation decreases purchasing power over time. Consumer Price Index (CPI) will be the proxy used to measure inflation in South Africa. The reasons for including inflation in this study is because South African's inflation has remained relatively high over the years, hence control of inflation is one of the dominant objectives of the central bank. Inflation raises a firm's production costs and therefore decreases its future cash flow, which lowers revenue as well as profits. In addition,

higher inflation will instigate the tightening of monetary policies which would have an adverse effect on stock prices discount rates and the cost of capital increases as investors demand more returns to compensate them for the inflation risk. Hence, on this reasoning a negative relationship between inflation and stock prices would be expected.

However, investors may also buy real assets such as shares as a hedge against inflation, hence they expect that the relationship is positive, at least in the medium term (Moores-Pitt, 2018 and Moores-Pitt and Strydom, 2017). This proxy has also been used in studies like Coetzee (2002), Olalere (2006), Banda (2017), Moores-Pitt and Strydom (2017), Moores-Pitt (2018) and Ndlovu *et al.* (2018).

4.3.2.1.16 Dummy Variables

Dummy variables were introduced into the model to capture the structural changes in the trend of various sector indices due to the long study period (June 1995 to December 2018). In this paper, three dummy variables will be employed. Dummy 1 represents the 1997 Asian crisis. Dummy 2 represents the 2002 Dot Com crisis. Dummy 3 represents the 2007 Financial crisis. These dummy variables effectively assess whether the conditional mean value of the dependent variable differs across the pre and post crisis periods. This paper employs only three dummy variables to avoid a dummy variable trap[5]. Studies which have included dummy variables are Junkin, (2011), Hamuda *et al*. (2013), Abdul-Rahim (2013) and Moores-Pitt (2018).

Table 1 justifies the time periods used in this paper for the dummy variables.

Table 1: Identification of crisis periods

| **Crisis** | **Start** | **End** | **Reference** |
|---|---|---|---|
| Asian Crisis | Jul-1997 | May-1998 | Baig and Goldfajn (1999) |
| Dot Com | Mar-2000 | Oct-2002 | Woollscheid (2012) |
| 2007 Financial Crisis | Jul-2007 | May-2009 | Dungey and Gajurel (2014) |

Author's computation

[5] Dummy variable trap is when independent variables are multi-collinear (Brooks, 2008)

### 4.4 Data description and sources

Table 2 summaries the variables, time period, sources and proxies used in this paper.

Table 2: Summary Data description and sources

| CODE | VARIABLES | TIME(MONTHLY) | SOURCE | PROXY |
|---|---|---|---|---|
| **J200** | JSE Top 40 | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J203** | JSE All Share Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J510** | JSE Basic Materials Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J520** | JSE Industrials Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J530** | JSE Consumer Goods Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J540** | JSE Health Care Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J550** | JSE Consumer Services Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J560** | JSE Telecommunications Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J580** | JSE Financials Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **J590** | JSE Technology Index | Jun 1995-Dec 2018 | INET BFA | Closing prices |
| **CI** | Domestic Coincident indicator | Jun 1995-Dec 2018 | SARB | Index 2015 = 100 |
| **ST** | Domestic Short term interest rate | Jun 1995-Dec 2018 | INVESTING | 3 months T-bill |
| **INF** | Domestic Inflation | Jun 1995-Dec 2018 | OECD.Stat | Percentage change |
| **REER** | Real effective exchange rate | Jun 1995-Dec 2018 | SARB | Index |

Author's computation

The macroeconomic variables have been selected based on theory and the frequency they are mentioned in the literature. The various sub-sectors of the JSE were selected based on their relative size in terms of market capitalization as well as their importance to the South African economy. Monthly data are used to capture short term changes in stock prices and macroeconomic variables. It is not possible to use weekly or daily data because macroeconomic variables such as inflation and the coincident indicator are calculated on a monthly basis.

### 4.5 Estimation Technique

In order to investigate the dynamic linkage between macroeconomic variables and various indices of the Johannesburg Stock Exchange, this study adopted the autoregressive distributed lag (ARDL) cointegration approach or bound testing method, that was proposed by Pesaran and Pesaran (1997), Pesaran and Shin (1998) and Pesaran *et al.* (2001). This procedure is chosen on account of its favourable properties compared to the traditional or conventional

cointegration techniques such as Engle and Granger (1987), Johansen (1988) and Johansen-Juselius (1990). According to Azeez and Obalade (2018) advantages of ARDL are: it can be used regardless of whether underlying variables are integrated I(0), I(1) or mutually co-integrated (but not I(2) as the procedure will crash), it is not sensitive to the size of sample (comfortably applied even under a small sample size), and it has better statistical properties providing unbiased estimates and valid t-statistics. ARDL cointegration approach can distinguish explanatory and explained variables, and enables testing the existence of linkage between the underling variables (Azeez and Obalade, 2018).

In order to avoid spurious results and to obtain good data analysis, it is necessary to ensure that no variable is integrated at level I (2) or beyond. In order to check the stationary status of the time series data of the variables Augmented Dickey-Fuller (ADF) and PP test are employed. Additionally, diagnostic tests which include normality, autocorrelation, heteroscedasticity and structural tests given the wide timeframe are carried out in order to generate the Best Linear Unbiased Estimator.

### 4.5.1 Stationarity Test

The first step of the process of testing for long or short run relationships between variables involves a test for stationarity and the order of the integration of the variables. In order to ascertain co-integration, the series must be integrated of the same order but not I(2) or beyond. Hence a test for the existence of unit root in the data series to determine stationarity and/or non-stationarity of the data is required. This study employs the use of the Augmented Dickey-Fuller (ADF) because of its quality of relaxing the postulation of autocorrelation among residuals (Khalid and Khan, 2017). However, to validate the ADF stationary results other tests like Phillips-Perron test will be employed. These tests ensure that shocks are only temporary and will dissipate and revert to their long-run means (Ouma and Muri, 2014). Augmented Dickey –Fuller (ADF) is an extension of Dickey -Fuller test (Banda, 2017). The ADF specification was employed by Banda (2017) and it is as follows:

$$\Delta y_t = \alpha_0 + \delta y_{t-1} + \sum^{\rho}{}_{i=1} \beta_i + y_{t-1} + \varepsilon_t \quad (6)$$

Where:

Δ = first difference

$y_t$ = the time series to be tested

$\alpha_0$= intercept

$\beta_i$= coefficient of interest in analysing the unit root

$\rho = \text{order of the autoregressive process and } \delta = p - 1$

$\varepsilon_t$= white noise error term

The null and alternative hypotheses are specified as:

$H_0$: $\rho = 1$ [Unit root i.e. Variable is not stationary]

$H_1$: $\rho = 0$ [No Unit root i.e. Variable is stationary]

From the hypothesis above the null hypothesis ($H_0$) tests if the series is not stationary hence the series contains a unit root. Rejection of the null hypothesis shows the series does not have a unit root and thus stationary. This is in contrast to the KPSS test, which tests the null hypothesis of the series being stationary, against the alternative hypothesis of the series being non-stationary (Brooks, 2008). If a series is nonstationary it has a higher possibility of generating a spurious regression which will produce a high $R^2$ even though there is no economic relation between variables (MacFarlane, 2011).

Determining the stationarity of a series is important because forecasts are only possible whilst using a stationary series and possibility of spurious regression is reduced (Chinzara and Aziakpono, 2009)

The ADF has its shortfalls. It is known to suffer potentially severe finite sample power and size problems (in the direction of over-rejecting the null) when the series has a large negative moving average root (Brooks, 2008).

### 4.5.2 Auto-Regressive Distributed Lag (ARDL) co-integration

Auto-Regressive Distributed Lag (ARDL) bounds testing approach was first proposed by (Pesaran and Pesaran 1997) and (Pesaran and Shin, 1998). Then, an advanced form of this approach to co-integration was developed by Pesaran *et al*. (2001) to model the long run determinants. As mentioned in section 4.5, the Auto-Regressive Distributed Lag (ARDL) method has a lot of advantages compared to the conventional approach to co-integration. In

this paper, equation (5) is presented in the ARDL framework as employed by Hamuda *et al.* (2013), Shah *et al.* (2012), Ho and Odhiambo (2015) and Nkoro and Uko (2016) as:

$$\Delta InY_t = \gamma_0 + \sum_{i=1}^{n} \gamma_{1i}\, \Delta InY_{t-1} + \sum_{i=0}^{n} \gamma_{2i}\, \Delta InCI_{t-1} + \sum_{i=0}^{n} \gamma_{3i}\, \Delta INF_{t-1} + \sum_{i=0}^{n} \gamma_{4i}\, \Delta ST_{t-1} + \sum_{i=0}^{n} \gamma_{5i}\, \Delta InREER_{t-1} + \gamma_{6i} D_1 + \gamma_{7i} D_2 + \gamma_{8i} D_3 + \delta_1 InY_{t-1} + \delta_2 InCI_{t-1} + \delta_3 INF_{t-1} + \delta_4 ST_{t-1} + \delta_5 InREER_{t-1} + \delta_6 D_1 + \delta_7 D_2 + \delta_8 D_3 + \varepsilon_t \quad (7)$$

Where $\varepsilon_t$, $\gamma$ *and* $\delta$ are the white noise error term, the short-run coefficients and the long run coefficients of the model, respectively. In addition, Δ is the first difference operator, t denotes time period and n is the maximum number of lags in the model.

It is important to note that when estimating the ARDL model, heteroscedasticity and autocorrelation consistent (HAC)[6] robust standard error technique on the ARDL model is employed to correct for both heteroscedasticity and autocorrelation (Gujarati, 2018). This ensures that the hypothesis tests and confidence intervals are accurate given the assumptions about the data and the model (Gujarati, 2018).

### 4.5.3 Optimal Lag Length

Before estimating the ARDL model, the optimum lag used should be set first (appropriate lag length *p*). The optimum lag length for variables is found by the vector autoregression (VAR) lag order selection/ information criteria method (Brooks, 2008). According to Liew *et al.* (2004), an auto regressive process with a lag length *p* refers to a time series in which its current value is dependent on its first *p* lagged values. However, *p* is always unknown therefore it has to be estimated through a lag length selection criterion such as the Akaike's information criterion (AIC) (Akaike 1973) or Schwarz information criterion (SIC) (Schwarz 1978) or Hannan-Quinn criterion (HQIC) (Brooks,2008).

For this study, owing to the large sample size (120 or greater), the SIC is most appropriate owing to its superior large sample properties as per Myung *et al.* (2009). However, it is worth noting that SIC embodies a much stiffer penalty term than AIC, while HQIC is somewhere in between (Brooks, 2008).

[6] HAC standard errors are preferable to White's standard errors because they correct for both autocorrelation and heteroscedasticity whereas White's standard errors correct only for heteroscedasticity (Gujarati, 2018).

SIC is strongly consistent (but inefficient) and AIC is not consistent, but it is generally efficient (Brooks, 2008). In other words, SIC will asymptotically deliver the correct model order, while AIC will deliver on average too large a model, even with an infinite amount of data (Brooks, 2008).

Below is the SIC popular information criteria expressed as (Brooks, 2008):

$$SIC=In(\sigma^2)+2k/T \quad (8)$$

Where $\sigma^2$ is the residual variance (also equivalent to the residual sum of squares divided by the number of observations, T). k=p+q+1 is the total number of parameters estimated and T is the sample size.

Correct lag length determination criteria are important as inaccurate results will affect Granger causality, impulse response functions and variance decompositions that may be calculated from the estimated VAR. Information criteria method has its problems like selecting a lower value lag length than the true lag length frequently generates auto correlated errors (Brooks, 2008).

### 4.5.4 Bounds Testing Procedure

The implementation of the ARDL approach involves two stages. First, the existence of the long-run nexus (cointegration) between the variables under investigation is tested by computing the F-statistics for analyzing the joint significance of the coefficients of the lagged levels of the variables. Pesaran *et al.* (2001) provided two sets of appropriate critical values for different numbers of regressors (variables). One set assumes that all the variables in the ARDL model are I(0), and another assumes that all the variables are I(1). If the F-statistic lies above the upper-bound critical value for a given significance level, the conclusion is that there is a non-spurious long-run level relationship with the dependent variable (Pesaran *et al.*, 2001). If the F-statistic lies below the lower bound critical value, the conclusion is that there is no long-run level relationship with the dependent variable (Pesaran *et al.*, 2001). If it lies between the lower and the upper limits, the result is inconclusive (Pesaran *et al.*, 2001). The approximate critical values for the F-test were obtained from Pesaran and Pesaran (1997). The general form of the null and alternative hypotheses for the F-statistic test is as follows and is employed by Shah *et al.* (2012), Hamuda *et al.* (2013), Nkoro and Uko (2016) and Ho and Odhiambo (2017):

$H0$: $\delta1=\delta2=\delta3=\delta4=\delta5=\delta6=\delta7=0$ (no cointegration)

Against the alternative $H1$: $\delta 1 \neq \delta 2 \neq \delta 3 \neq \delta 4 \neq \delta 5 \neq \delta 6 \neq \delta 7 \neq 0$ (existence of cointegration) [7]

Secondly, if the variables are found to be cointegrated, the analysis must proceed to estimate the short run Error-Correction Model (ECM) behaviour of the variables using error-correction model. According to Majid and Yusof (2009), the ECM integrates the short run dynamics with the long run equilibrium, without losing long-run information. Below is the following ECM model as employed by Kwofie and Ansah (2018), Mohamed and Ahmed (2018) and Azeez and Obalade (2018):

$$\Delta InY_t = \gamma_0 + \sum_{i=1}^{n} \gamma_{1i}\, \Delta InY_{t-1} + \sum_{i=0}^{n} \gamma_{2i}\, \Delta InCI_{t-1} + \sum_{i=0}^{n} \gamma_{3i}\, \Delta INF_{t-1} + \sum_{i=0}^{n} \gamma_{4i}\, \Delta ST_{t-1} + \sum_{i=0}^{n} \gamma_{5i}\, \Delta InREER_{t-1} + \gamma_{6i} D_1 + \gamma_{7i} D_2 + \gamma_{8i} D_3 + \delta ECM_{t-1} + \varepsilon_t \quad (9)$$

Where, $\delta$ is the speed of adjustment parameter or coefficient of the error-correction term, $ECM_{t-1}$. $\delta$, is expected to have a negative sign and it should be significant. This means that when the variables drift apart from the equilibrium levels in the short run, they can adjust back to their equilibrium levels.

Lastly, if the variables are found to be not cointegrated, the analysis must proceed to estimate the short run regression using OLS:

$$\Delta InY_t = \gamma_0 + \sum_{i=1}^{n} \gamma_{1i}\, \Delta InY_{t-1} + \sum_{i=0}^{n} \gamma_{2i}\, \Delta InCI_{t-1} + \sum_{i=0}^{n} \gamma_{3i}\, \Delta INF_{t-1} + \sum_{i=0}^{n} \gamma_{4i}\, \Delta ST_{t-1} + \sum_{i=0}^{n} \gamma_{5i}\, \Delta InREER_{t-1} + \gamma_{6i} D_1 + \gamma_{7i} D_2 + \gamma_{8i} D_3 + \varepsilon_t \quad (10)$$

### 4.6 Diagnostic Tests

The model that has been used for testing the short and long run relationship and coefficients is further tested with the diagnostic tests of serial autocorrelation, heteroscedasticity, stability and normality tests.

#### 4.6.1 Autocorrelation

Autocorrelation means that error terms are correlated with each other across observations (Brooks, 2008). Presence of autocorrelation in a series will cause the standard errors to be incorrectly calculated such that the estimates will be unbiased but will not be efficient, so t and F tests are invalid (Brooks, 2008). Additionally, $R^2$ is overstated (Brooks, 2008). There are

[7] Hamuda *et al.* (2013) and Abdul-Rahim (2013) used dummy variables in their bounds test.

many tests in literature such as the Durbin-Watson (D-W) test, Durbin's h test, Breusch-Godfrey LM test, etc. which are applied to check for serial correlation. However for this paper the Breusch- Godfrey LM will be employed to check the presence of serial correlation as Khalid and Khan (2017) used the method in their study.

$H_0$: $\rho$=0 (no autocorrelation)

$H_0$: $\rho \neq 0$ (autocorrelation)

If the probability value < α = 5%, reject $H_0$, hence data does not contain the problem of autocorrelation.

### 4.6.2 Heteroscedasticity

Heteroscedasticity is when the variance of error terms is not constant (Brooks, 2008). It will cause the standard errors to be incorrectly calculated such that the estimates will be unbiased but will not be efficient, so t and F tests are invalid (Brooks, 2008). There are various tests of determining heteroscedasticity namely, Breusch-Pagan-Godfrey, Harvey, Glejser and ARCH. For this paper, the ARCH test will be employed as followed by Joshi (2015) and Chia and Lim (2015). To determine whether a residual is heteroscedastic or homoscedastic, a statistical test is done by using the following hypotheses:

$H_0$: $Var(u_t) = \sigma^2$(residuals are homoscedastic)

$H_1$:$Var(u_t) \neq \sigma^2$ (residuals are heteroscedastic)

If the probability value probability value < α = 5% then reject $H_0$, therefore it means residuals are heteroscedastic.

## **4.7** Normality Test

The normality test is used to investigate whether the residuals (or the disturbances) follow a normal distribution or not. For this purpose, the Jarque-Bera test (1987) has been applied to check for the following null hypothesis against the alternative hypothesis.

$H_0$: Residuals follow normal distribution

$H_1$: Residuals do not follow normal distribution

If the p-value is more than 5%, fail to reject the null hypothesis that the residuals are normally distributed.

### 4.8 Stability Tests

The stability of the model and coefficients are checked through the CUSUM and CUSUM-SQ, while the graphical presentation of the recursive coefficients is used to judge the stability of the coefficient.

#### 4.8.1 CUSUM

CUSUM (cumulative sum of recursive residuals) developed by Brown *et al.* (1975). The CUSUM test takes the cumulative sum of residuals and plots its value against the upper and lower bounds of the 95% confidence interval at each point (Brown *et al.*, 1975). The test finds parameter instability if the cumulative sum goes outside the area between the two 5% critical lines. The CUSUM test is given below as followed by Khalid and Khan (2017):

$$CUSUM_t = W_t = \sum_{r=k+1}^{t} \frac{w_r}{s_r} \quad (11)$$

Where:

W = the recursive residual, s = S.E of the regression fitted to all T sample size, t = k+1, …, T If the vector remains constant, then it has zero mean [i.e. E ($W_t$) = 0] and variance that is proportional to t – k - 1. But if $\beta$ vector does not remain constant, $CUSUM_t$ will incline to diverge from the mean line.

#### 4.8.2 CUSUMSQ

The CUSUM of Squares test is to ensure the robustness of the result for CUSUM test (Khalid and Khan, 2017). It accesses the cumulative variance around the regression (Brooks, 2008). CUSUMSQ statistic is given below as followed by Khalid and Khan (2017):

$$CUSUMSQ_t = S_t = \frac{\sum_{r=k+1}^{t} w_r^2}{\sum_{r=k+1}^{T} w_r^2} \quad (12)$$

If the parameters remain constant, then the expected value of 'S' will be as,

$$E(S_t) = (t-k)/(T-k)$$ which goes from 0 at t = k to one at t = T. (13)

## 4.9 Conclusion

This chapter has focused on the analytical framework for the empirical analysis in the next chapter. The thesis will follow the positivist paradigm because of its unique attributes. The model specified for estimation is adapted from Chen *et al.* (1986). In order to investigate the objectives of the thesis, an ARDL statistical technique approach will be employed. It is important to follow every step in order to generate accurate results. The next chapter will focus on the presentation and interpretation of the output. It will also present and analyse the findings.

# CHAPTER 5: EMPIRICAL RESULTS

## 5.1 Introduction

This chapter reports on the diagnostic tests and on the econometric findings of the ARDL models for the time period, June 1995 to December 2018 and the sub-periods, June 1995 to June 2007 and July 2007 to December 2018. The signs and significance of the coefficients of each of the macroeconomic variables are presented and discussed for each time period for the JSE All Share Index and the various sectoral sub-indices. The results are compared with *a priori* expectations and the findings of the South African and international literature. Possible explanations for unexpected findings are provided.

## 5.2 Descriptive Statistics

Descriptive statistics for the macroeconomic variables and the various sub-sector stock market indices used in this study are presented in Appendices 5.1, 5.2 and 5.3, for the full period, June 1995 to December 2018 and the two sub-periods June 1995 to June 2007 and July 2007 to December 2018, respectively. The descriptive statistics include measures of mean and variability (standard deviation, range, minimum and maximum) and the Jarque-Bera test for normality and are used to better understand the dataset being used for econometric modelling.

### 5.2.1 June 1995 to December 2018

Appendix 5.1 reports on the mean, median and standard deviation of the variables. Technology Index (J590) has the highest average. Consumer Goods Index (J530) has the highest standard deviation. In terms of the skewness, JSE Basic Materials Index (J510), coincident indicator (CI), real effective exchange rate (REER) and inflation (INF) are negatively skewed, while the remaining variables are positively skewed. In terms of the kurtosis statistic, the JSE Consumer Services Index (J550), short term interest rate (ST) and inflation are leptokurtic (high peak/long tailed). The remaining variables are all platykurtic (lower peak/short tailed). The Jarque-Bera statistic reveals that only real effective exchange rate (REER) is normally distributed, as its corresponding probability value is more than 5%. The corresponding probability value for all the remaining variables is less than 5% and hence, the null hypothesis that the variable is normally distributed is rejected.

### 5.2.2 June 1995 to June 2007

Appendix 5.2 reports on the mean, median and standard deviation of the variables. Similar to the whole period, June 1995 to December 2018, Technology Index (J590) has the highest average. However, Technology Index also has the highest standard deviation, which is different to the whole period findings. In terms of the skewness, all of the variables of the model are positively skewed except for inflation and real effective exchange rate which are negatively skewed. Furthermore, the kurtosis statistics of the dataset show the JSE Technology Index (J590), short term interest rate and inflation are platykurtic, whilst the remaining variables are leptokurtic. The Jarque-Bera statistic confirms that only inflation is normally distributed as the corresponding probability value is more than 5%. However, the remaining variables are not normally distributed.

### 5.2.3 July 2007 to December 2018

For the second sub period the results in Appendix 5.3 indicates, Consumer Goods Index (J530) has the highest average and standard deviation. It is not surprising that the coincident indicator (CI) for the July 2007 to December 2018 is lower compared to June 1995 to June 2007 sub period because of the 2007 global crisis which slowed down economic growth. In terms of the skewness, all of the given variables of the model are positively skewed except for JSE Top 40 (J200), JSE All Share Index (J203), JSE Industrials Index (J520) and the coincident indicator. Furthermore, kurtosis statistics shows that the JSE Basic Materials Index, short term interest rate and inflation are leptokurtic. The remaining variables are platykurtic. The Jarque-Bera statistic confirms similar results to the whole period that only the real effective exchange rate is normally distributed because the corresponding probability value is more than 5%. However, the remaining variables are not normally distributed.

## 5.3 Test for Non-Stationarity

The stationary results for each time period: Appendices 5.4 and 5.5 show the summary of the ADF and PP tests results for the June 1995 to December 2018 period, Appendices 5.6 and 5.7 show the results for the June 1995 to June 2007 sub-period and Appendices 5.8 and 5.9 show the results for the July 2007 to December 2018 sub-period.

### 5.3.1 ADF and PP tests for the full period, June 1995 to December 2018

The results of the ADF and PP tests for the full period, shown in Appendices 5.4 and 5.5, indicate that all the variables are non-stationary (have a unit root) at levels for the ADF test with an intercept only except for the coincident indicator which is significant at the 10% level. However, in terms of the ADF test at levels with both an intercept and trend, all the variables are non-stationary. For the first differences, the statistics for all the variables are significant in terms ADF (intercept) and ADF (intercept and trend) at the 1% level, which means they are stationary in first differences (integrated of order one).

For the PP test on the variables in level form with an intercept, the test results indicate that the variables are all non-stationary except for the coincident indicator and short term interest rate which are significant at 10% and 1% levels, respectively. However, when the intercept and trend term are included in the PP test, all of the variables are non-stationary as the test statistics are insignificant except for short term interest rate which is significant at 5% level. In terms of the first differences, both the PP with an intercept and with both an intercept and trend, reveal that the variables are stationary at the 1% significance level, which means they are stationary in first differences (integrated of order one).

### 5.3.2 ADF and PP tests for the June 1995 to June 2007 sub period

Appendices 5. 6 and 5.7 presents the summary of the ADF and PP tests results for the June 1995 to June 2007 sub period. The results show that all the variables are non-stationary (have a unit root) at levels for both forms of the ADF test. While, the first difference of all the variables are stationary at the 1% significance level, except for the coincident indicator which is significant at 10% for both forms of the ADF test. The results for the PP test with an intercept show that all the variables are non-stationary (have a unit root) at levels expect for inflation which is significant at the 10% level. PP test in levels for both intercept and trend show that all the variables are non stationary. In terms of the PP test in first difference with intercept only and both an intercept and trend, all the variables are non-stationary, as with the ADF test findings. Hence, are integrated of order one.

### 5.3.3 ADF and PP test for July 2007 to December 2018 sub-period

The results in Appendices 5.8 and 5.9 show that for the levels test ADF test with an intercept, only the JSE Basic Materials index (J510) is stationary at the 10% significance level, whilst

the test statistics for the remaining variables are insignificant meaning that the null hypothesis of a unit root cannot be rejected. However, for the levels ADF test with an intercept and trend, all the variables are insignificant. Likewise, the PP test with an intercept also revealed that only the JSE Basic Materials index is stationary at the 5% significance level, whilst the remaining variables are non-stationary. However, for the levels PP test with an intercept and trend all the variables are found to be non-stationary. For the first difference, both forms of both tests show that the variables are stationary at the 1% significance level.

#### 5.3.4 Implications of Stationarity results

The results explained in all three periods above clearly show that all the variables are integrated of order I (1). Hence it will suitable to perform the ARDL model. The next step of the ARDL model is to determine the optimum lag length.

## 5.4 Optimal Lag Selection

Appendices 5.10, 5.11 and 5.12 present the results of the lag order selection criteria for the various periods based on the SIC. As can be seen, the optimal lag length for all periods is one.

## 5.5 Bounds Tests Results

Appendices 5.13, 5.14 and 5.15 show a summary of the bound test results for the various periods.

#### 5.5.1 Bounds tests results for June 1995 to December 2018

From the results provided in Appendix 5.13, only the JSE Basic Materials Index (J510) is not cointegrated with the macroeconomic variables, as the F-static (2.80) lies between the lower and upper bound for all significance levels, hence implying that the result is inconclusive. However, for the remaining stock market indices, there is cointegration meaning that the null hypothesis of no co-integration is rejected, hence there is a long run relationship between each stock market index and the independent variables.

#### 5.5.2 Bounds test results for June 1995 to June 2007 sub period

For the first sub-period, the results (shown in Appendix 5.14) reveal that JSE Consumer Goods Index (J530), Telecommunications Index (J560) and Financials Index (J580) are not cointegrated with the macroeconomic variables as the F-statics, 2.25, 2.76 and 2.62,

respectively, lies below the lower bound at varies significance levels, hence the null hypothesis of no co-integration is not rejected, meaning there is a no long run relationship. However, for the remaining regressions, there is cointegration, meaning that the null hypothesis of no co-integration is rejected, hence there is a long run relationship with the remaining dependent variables.

### 5.5.3 Bounds test results for July 2007 to December 2018 sub-period

From the results provided in Appendix 5.15 it shows for the second sub-period, the cointegration results indicate that there are several indices that are not cointegrated with the macroeconomic variables, namely the Basic Materials Index (J510), Industrials Index (J520), Consumer Goods Index (J530) and Consumer Services Index (J550). However, for the remaining regressions, there is cointegration, meaning that the null hypothesis of no co-integration is rejected, hence there is a long run relationship with the each stock market index and the independent variables.

### 5.5.4 Summary on the Bounds test results

Clearly from the results shown in the bounds test results for the various periods, the results are not same. For the whole period, Basic Materials Index (J510) is not cointegrated with the macroeconomic variables. In terms of the June 1995 to June 2007 sub period, Consumer Goods Index (J530), Telecommunications Index (J560) and Financials Index (J580) have no long run with the various macroeconomic variables. The July 2007 to December 2018 sub-period shows that Basic Materials Index (J510), Industrials Index (J520), Consumer Goods Index (J530) and Consumer Services Index (J550) are not cointegrated with the macroeconomic variables. Similarities among the periods is that, Basic Materials Index (J510) is not cointegrated with the macroeconomic variables in both the whole period and July 2007 to December 2018 sub-period. However, Consumer Goods Index (J530) has no long run with the macroeconomic variable in both sub periods.

## 5.6 ARDL Results

Tables 3 and 4 below show the results for the structural break test on various indices for all three periods in the long and short run, respectively.

### 5.6.1 Testing for structural change in the long run

Table 3: Results for structural breaks in the long run

| Time period | Variables | J200 | J203 | J510 | J520 | J530 | J540 | J550 | J560 | J580 | J590 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Dec 2018** | **ASIAN CRISIS** | Na | Na | -*** (NC) | Na | Na | Na | Na | Na | Na | Na |
| | **DOT COM** | Na | Na | Na (NC) | Na | Na | Na | -*** | -** | Na | Na |
| | **2007 CRISIS** | Na | Na | Na (NC) | Na | Na | Na | -* | +* | -* | Na |
| **Jun 1995-Jun 2007** | **ASIAN CRISIS** | Na | Na | -** | Na | Na (NC) | Na | Na | Na (NC) | Na (NC) | Na |
| | **DOT COM** | Na | Na | -*** | Na | Na (NC) | Na | Na | Na (NC) | Na (NC) | Na |
| **Jul 2007-Dec 2018** | **2007 CRISIS** | Na | Na | +** (NC) | Na (NC) | Na (NC) | Na | -** (NC) | +** | Na | Na |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

#### 5.6.1.1 Asian crisis dummy

The results in table 3 show that for the whole period, all the indices are insignificantly related to the Asian crisis dummy, hence no presence of structural breaks. In terms of the June 1995 to June 2007 sub period, only Basic Materials Index (J510) is negatively related to the Asian crisis dummy at the 5% level, hence evidence of structural break for this index. The remaining indices are insignificant.

#### 5.6.1.2 Dot com dummy

In terms of the June 1995 to December 2018 period, the results in table 3 show that, the Consumer Services Index (J550) and Telecommunications Index (J560) are negatively related to the Dot com dummy at the 10% and 5% significance levels, respectively. Hence there is evidence of structural breaks for these indices. However, the remaining indices are insignificantly related to the Dot com dummy, hence no evidence of structural breaks. In terms of the June 1995 to June 2007 sub period, only Basic Materials Index is negatively related to

the dummy variable at the 10% level, hence presence of structural break for this index. The remaining indices are insignificant.

#### 5.6.1.3 2007 crisis dummy

In terms of the full period, the results in table 3 show that both Consumer Services Index (J550) and Financials Index (J580) are both negatively related to the 2007 crisis dummy at the 1% level. The Telecommunications Index (J560) is positively related at 1% significance level. Hence, presence of structural break in the models. However, the remaining indices are not influenced by the 2007 crisis dummy variable. In terms of the July 2007 to December 2018 sub-period, only Telecommunications Index (J560) is positively related to the 2007 crisis dummy at the 5% level, hence the financial crisis impacted the index, hence presence of structural break in the model.

### 5.6.2 Testing for structural change results in the short run

Table 4: Results for structural breaks in the short run

| Time period | Variables | D(J200) | D(J203) | D(J510) | D(J520) | D(J530) | D(J540) | D(J550) | D(J560) | D(J580) | D(J590) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jun1995-Dec2018** | **ASIAN CRISIS** | Na | Na | +** | +*** | Na | Na | Na | Na | Na | +*** |
| | **DOT COM** | Na | Na | Na | Na | Na | Na | Na | -** | Na | -* |
| | **2007 CRISIS** | Na | Na | Na | -*** | Na | Na | Na | Na | -** | Na |
| **Jun1995-Jun2007** | **ASIAN CRISIS** | Na | Na | Na | Na | Na | Na | Na | Na | Na | Na |
| | **DOT COM** | Na | Na | Na | Na | Na | Na | -** | -* | -** | -* |
| **Jul2007-Dec2018** | **2007 CRISIS** | Na | Na | Na | -** | Na | Na | Na | Na | -* | Na |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

#### 5.6.2.1 Asian crisis dummy

In terms of the June 1995 to December 2018 period, the results in table 4 show that, Basic Materials Index (J510), Industrials Index (J520) and Technology Index (J590) are positively related to the Asian crisis dummy at 5%, 10% and 10% levels, respectively, thus presence of

structural break. However, the remaining variables are insignificant. In terms of the June1995 to June 2007 sub period, all the variables are insignificantly related to the dummy variable.

#### 5.6.2.2 Dot com dummy

Results in table 4 show that for the whole period, Telecommunications Index (J560) and Technology Index (J590) are negatively related to the Dot com dummy at 5% and 1% levels, respectively. However the remaining indices are not impacted by the dummy. In terms of the June 1995 to June 2007 sub period, Consumer Services Index (J550) and Financials Index (J580) are both negatively related to the dummy at 5% level, whilst Telecommunications Index (J560) and Technology Index (J590) are both positively related to the Dot com dummy at 1% level. Hence, presence of structural breaks exist within the models. However, the remaining indices are insignificant.

#### 5.6.2.3 2007 crisis dummy

In terms of the whole period, Industrials Index and Technology Index are negatively related to the 2007 crisis dummy at 10% and 5% levels, respectively. However the remaining indices are not influenced by the dummy variable. July 2007 to December 2018 sub-period shows similar findings to the whole period except the significance levels are different. Industrials Index (J520) and Technology Index (J590) are negatively related to the dummy at 5% and 1% levels, respectively.

### 5.7 Impact of the coincident indicator on JSE All Share Index and sector indices

Tables 5 and 6 show the signs and significance level between the coincident indicator and various indices in the long run and short run, respectively.

#### 5.7.1 Long run

Table 5: Results of the coincident indicator and various indices in the long run

| Time period | InJ200 | InJ203 | InJ510 | InJ520 | InJ530 | InJ540 | InJ550 | InJ560 | InJ580 | InJ590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Dec 2018** | +* | +* | Na (NC) | +* | Na | Na | Na | Na | +* | Na |
| **Jun1995-Jun 2007** | +* | +* | +* | +* | Na (NC) | +* | Na | Na (NC) | +* (NC) | Na |
| **Jul 2007-Dec 2018** | +* | +* | Na | +* | Na | Na | +* | Na | +* | Na |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (NC) | (NC) | (NC) | | (NC) | | | |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

The results in Table 5 show that the coincident indicator is positively related to the JSE All Share Index (J203) in the long run at the 1% level, for all periods analysed. This finding is consistent with *a priori* expectations, as a higher coincident indicator implies an increase in economic activity, hence increases in firms' turnover and profits, and thus stock price increases. In terms of South African empirical evidences this view is reaffirmed by results from Jefferis and Okeahalam (2000), Coovadia (2014) and Muchaonyerwa and Choga (2015). However, Coetzee (2002), MacFarlane (2011) and Ndlovu *et al.* (2018) found contradictory results.

The results also show that for the June 1995 to December 2018 period, of the sector indices, only the JSE Top 40 Index (J200), the Industrials Index (J520) and the Financials Index (J580) are positively related to the coincident indicator at the 1% level in the long run. JSE Basic Materials Index (J510) relationship with coincident indicator results was inconclusive as shown in Appendix 5.13 that the F static is between the lower and upper bound. However, the remaining indices are insignificant. Surprisingly, the Consumer Services Index (J550) and Consumer Goods Index (J530) was insignificant since South Africa is a consumption based economy. The findings for the JSE Top 40 Index, the Industrials Index and Financials Index are again consistent with economic theory. The finding for the Top 40 Index are consistent with Gupta and Reid (2013) study although it was positively insignificant. The Industrials Index results affirm with studies by Junkin (2011) and Hackland (2016). However, Banda (2017) surprisingly found no relationship. The Financials Index results are consistent with empirical evidence by Al-Shubiri (2010) and Hackland (2015), however, Ihsan *et al.* (2007) found a negative relationship. The findings of no long run relationship with Basic Materials Index are contrary to *a priori* expectations as well as the findings by Junkin (2011) who found the relationship to be positive and significant.

For the June 1995 to June 2007 sub-period, the results in Table 5 shows that the JSE Top 40 and the Industrials Index are again positively related to the coincident indicator at the 1% level. Importantly, the Basic Materials Index and Health Care Index (J540) are now positively related

to the coincident indicator at the 1% level for this sub-period (but not for the period June1995 to December 2018 as a whole) and the Financials Index, which was positively related for the period June 1995 to December 2018 has no long run relationship with the coincident indicator for the sub-period. The finding of a positive relationship for the Basic Materials Index for this sub-period (although not for June 1995 to December 2018 period) is consistent with the study done by Junkin (2011). The Health Care Index results are consistent with a study by Junkin (2011). The Consumer Services and Technology Indices were not significantly related, while the Consumer Goods Index and the Telecommunications Index had no long run relationship with the coincident indicator.

Findings for the July 2007 to December 2018 sub period in Table 5, show that the JSE Top40 and the Financials Index are positively related to coincident indicator at both 1% level, respectively. However, Health Care Index, Telecommunications Index and Technology Index are insignificant. Basic Materials Index, Industrials Index, Consumer Goods Index and Consumer Services Index have no long run relationship with the coincident indicator.

These results have important implications. The differences between the two sub periods suggest that the importance of the coincident indicator for stock market performance in the long run has weakened post-2007. This is unsurprising as economic activity has been lower post the global financial crisis because of strikes, high crime rate and loss of business confidence due to political instability and xenophobic attacks. It can be shown that the importance of coincident indicator for stock market performance has weakened post-2007 by comparing the coefficients for the two sub-periods between the coincident indicator and JSE All Share Index. Pre crisis period results in Appendix 5.17, show that JSE All Share Index over the June 1995 to June 2007 period moves 3.11% when there is a 1% change in the coincident indicator. Post crisis period results in Appendix 5.28 show that JSE All Share Index over the July 2007 to December 2018 moves 2.60% when there is 1% change in the coincident indicator. This means that if investors want to benefit from an increasing coincident indicator, according to Table 5 they need to invest in JSE All Share Index and JSE Top 40 Index. However, if they want to hedge against a recession or bearish market, indices like the Technology Index and Telecommunications Index which are insignificantly related to the coincident indicator in all periods, would be best.

According to Banda (2017), the reason why there is no relationship between some indices and the coincident indicator is that the markets have become so integrated that global markets today

matter more than local markets for stock market performance. As a result, whilst growing economic activity in the local market is helpful, in a highly globalised economy, this might be outweighed by economic activity in the rest of the world in determining local share prices.

### 5.7.2 Short run

Table 6: Results of the coincident indicator and various indices in the short run

| Time period | D(J200) | D(J203) | D(J510) | D(J520) | D(J530) | D(J540) | D(J550) | D(J560) | D(J580) | D(J590) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Dec2018** | +* | +* | +** | +** | +* | Na | +** | +*** | +*** | +** |
| **Jun 1995-Jun 2007** | +* | +* | +*** | +** | +** | +*** | Na | Na | Na | Na |
| **Jul 2007-Dec 2018** | +*** | +*** | Na | Na | +*** | Na | Na | Na | Na | +* |

Author's Computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

The results in Table 6 show that the coincident indicator is positively related with JSE All Share Index (J203) at 1%, 5% and 10% levels of significance, for the whole period and both sub-periods, June 1995 to June 2007 and July 2007 to December 2018. Supporting studies are Jefferis and Okeahalam (2000) and Coovadia (2014).

In terms of the full time period June 1995 to December 2018, of the sector indices the JSE Top 40 Index (J200) and Consumer Goods Index (J530) are both positively related to coincident indicator at the 1% levels. Basic Materials Index (J510), Industrials Index (J520), Consumer Services Index (J550) and Technology Index (J590) are all positively related at the 5% level. Telecommunications Index (J590) and Financials Index (J580) are both positively related at the 10% significance levels. Only, Health Care Index (J540) is insignificant.

Importantly the results in Table 6 show that for June 1995 to June 2007 sub-period, the JSE Top 40 Index, Basic Materials Index, Industrials Index, Consumer Goods Index and Health Care Index are positively related to the coincident indicator at the varying significance levels respectively. However, the remaining indices are insignificantly related. These insignificant indices in June 1995 to June 2007sub-period are all significant in the whole period. Health Care Index which is insignificant in the whole period is significant in the June 1995 to June 2007 sub period.

For the July 2007 to December 2018 sub period the findings in Table 6 show that the JSE Top 40 Index, Consumer Goods Index and Technology Index are positively related to the coincident indicator at 10%, 10% and 1% levels, respectively. However, the remaining indices are insignificant.

These results have important implications. The differences between the two sub periods (Appendices 5.20 and 5.21) suggest that the importance of the coincident indicator for stock market performance has also weakened in the short run post the global financial crisis. The reason for weakening of the coincident indicator for stock market performance has been explained in section 5.7.1. To show that the importance of coincident indicator for stock market performance has weakened post-2007 in the short run the coefficients of coincident indicator in relation to JSE All Share Index can be compared for the two sub-periods, in Appendices 5.20 and 5.21. Pre crisis period results in Appendix 5.20 show that JSE All Share Index moves 1.93% in the short run when there is a 1% change in the coincident indicator. Post crisis results in Appendix 5.21 shows that JSE All Share Index moves 1.12% in the short run when there is 1% change in the coincident indicator.

The results suggest that investors can benefit from an increasing coincident indicator in the short run by investing in JSE All Share Index and JSE Top 40 Index which are influenced positively by the coincident indicator in all periods as shown in table 6. It is important to note this short run finding is similar to the long run. However, to hedge against a decreasing coincident indicator, investors can invest in Consumer Services Index, Telecommunications Index and Financials Index as these indices are insignificantly related to the coincident indicator is most of the periods.

## 5.8 Impact of the inflation rate on JSE All Share Index and sector indices

Tables 7 and 8 show the signs and significance level between inflation and various indices in the long run and short run, respectively.

### 5.8.1 Long run

Table 7: Results of the inflation and various indices in the long run

| Time period | J200 | J203 | J510 | J520 | J530 | J540 | J550 | J560 | J580 | J590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jun1995-Dec 2018** | Na | Na | Na (NC) | Na | Na | Na | Na | Na | Na | Na |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Jun 2007** | Na | Na | Na | Na | Na (NC) | Na | Na | Na (NC) | Na (NC) | Na |
| **Jul 2007-Dec 2018** | -** | -* | Na (NC) | Na (NC) | Na (NC) | Na | Na (NC) | Na | Na | Na |

Author's computation from Eviews 10

Notes*:* (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

The results in Table 7 show that inflation is negatively and significantly related with the JSE All Share Index (J203) at the 5% level, for the July 2007 to December 2018 sub period. However, for the whole time period and the June 1995 to June 2007 sub period, inflation is insignificant related to the all various indices. The negative relationship between inflation rate and JSE All Share Index is consistent with *a priori* expectations, which suggest that inflation's impact on stock market prices is ambiguous. As inflation raises firms' production costs it therefore decreases their future cash flows which lowers revenue as well as profits. In terms of local literature review this view is reaffirmed by results from Coetzee (2002), Olalere (2006), Beukes (2009) and Ntshangase *et al.* (2016). However, share prices and other real assets may provide a hedge against inflation, support for which has been found by Coovadia (2014), Morres-Pitt and Strydom (2017), Morres-Pitt (2018) and Ndlovu *et al.* (2018).

For the sector indices, the full time period, June 1995 to December 2018 and June 1995 to June 2007 sub period, as shown in Table 7 all the sector indices are insignificant. July 2007 to December 2018 sub period results show that only JSE Top 40 Index (J200) is negatively related to inflation at the 1% level. However, the remaining indices are insignificant. JSE Top 40 Index finding is consistent with study by Hackland (2016).

It is not surprising that most of the sector indices are insignificant because of ambiguous *a priori* expectations. The rise of enhanced tools for managing inflation rate risk like, for instance gold or inflation-linked bonds may reduce the stock market's importance as a hedge against inflation. Important differences are observed between the full time period June 1995 to December 2018 and the two sub-periods June 1995 to June 2007 and July 2007 to December 2018. For the full time period none of the indices are significant, including the All Share Index. The same findings apply to the June 1995 to June 2007 sub period. Only the July 2007 to December 2018 sub period has significant variables.

The findings of the negative relationship between JSE All Share Index, JSE Top 40 Index and the inflation rate in the post-crisis period as shown in Table 7 has tentative implications. If the relationship for this sub period is sustained, then when inflation rises investor should be wary of indices such as JSE All Share Index and JSE Top 40 Index as these indices were negatively impacted in the post crisis period. Results in Appendix 5.18 suggest that the All Share Index decreases by 8.10% as inflation rate increases by 1 percent point, whilst JSE Top 40 decreases by 8.17%. If investors want to hedge against inflation in the post crisis period, they need to switch to alternative sectors that are still not significantly impacted by inflation, for instance, Health Care Index, Telecommunications Index, Financials Index and Technology Index.

### 5.8.2 Short run

Table 8: Results of inflation and various indices in the short run

| **Time period** | **D(J200)** | **D(J203)** | **D(J510)** | **D(J520)** | **D(J530)** | **D(J540)** | **D(J550)** | **D(J560)** | **D(J580)** | **D(J590)** |
|---|---|---|---|---|---|---|---|---|---|---|
| Jun 1995-Dec 2018 | Na | Na | Na | Na | Na | Na | Na | Na | Na | Na |
| Jun 1995-Jun 2007 | Na | Na | Na | +** | Na | Na | Na | Na | +*** | Na |
| Jul 2007-Dec 2018 | Na | Na | Na | Na | -** | -** | -* | Na | Na | Na |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

The results in Table 8 show that in terms of all periods, JSE All Share index (J203) is insignificantly impacted by inflation in the short run. For the full time period in Table 8, none of the sector indices are significantly related to inflation. In terms of the June 1995 to June 2007 sub period, only Industrials Index (J520) and Financials Index (J580) are positively related to inflation at the 5% and 10% levels, respectively. The remaining sub-indices are insignificant. The positive relationship between Industrials Index (J520), Financials Index (J580) and inflation in the June 1995 to June 2007 sub period, implies that those sector indices hedge against inflation.

The July 2007 to December 2018 sub period findings in Table 8 show that Consumer Good Index (J530), Health Care Index (J540) and Consumer Services Index (J550) are all negatively related to inflation at the 5%, 5% and 1% significance level, respectively. However, the remaining sector indices are insignificant.

If the findings in the July 2007 to December 2018 sub period are sustained, investors should take note of Consumer Goods Index, Health Care Index and Consumer Services Index (J550) when inflation increases, as those indices were impacted negatively in the most recent sub period. Consumer Services Index has the highest responsiveness rate to changes in inflation as shown in Appendix 5.21.

Appendix 5.21 shows that Consumer Services Index decreases by 4.38% as the inflation rate increases by 1 percent point in the short run. However, various sector indices that are not influenced by inflation can be alternative to hedge against inflation, for instance, JSE All Share Index, JSE Top 40 Index, Basic Materials Index (J510), Industrials Index, Telecommunications Index (J560) and Technology Index (J590).

## 5.9 Impact of the short-term rate on JSE All Share Index and sector indices

Tables 9 and 10 show the signs and significance level between the short term interest rate and various indices in the long run and short run, respectively.

### 5.9.1 Long run

Table 9: Results of short-term interest rate and various indices in the long run

| Time period | InJ200 | InJ203 | InJ510 | InJ520 | InJ530 | InJ540 | InJ550 | InJ560 | InJ580 | InJ590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Dec 2018** | -* | -* | -* (NC) | Na | Na | -*** | Na | -* | Na | Na |
| **Jun 1995-Jun 2007** | -* | Na | Na | -* | Na (NC) | Na | Na | Na (NC) | Na (NC) | Na |
| **Jul 2007- Dec 2018** | Na | Na | Na (NC) | Na (NC) | Na (NC) | Na | Na (NC) | -* | Na | +*** |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated; (4) – or + denotes the sign of the coefficient

The results in Table 9 show that the short term interest rate is negatively and significantly related with the JSE All Share index (J203) at the 1% level, only for the whole period June 1995 to December 2018 period. However, for both sub periods it is surprisingly insignificant. The negative relationship between short term interest rate and JSE All Share Index is consistent with *a priori* expectations. The theoretical basis for the conventional prediction is that a decrease in interest rates will lower borrowing costs for firms, hence resulting in higher future

profits and thus higher stock prices. Lower interest rates also make shares more attractive relative to cash in investors' portfolios of assets. This view is reaffirmed by results from South Africa literature review namely Jefferis and Okeahalam (2000), Coetzee (2002), MacFarlane (2011), Muchaonyerwa and Choga (2015) and Ntshangase *et al.* (2016) who all found a negative relationship between the interest rate and the JSE All Share Index. However, Beukes (2009) and Ndlovu *et al.* (2018) found a positive relationship.

In terms of the full time period results, for the sector indices in Table 9, show that the JSE Top 40 Index (J200), Health Care Index (J540) and Telecommunications Index (J560) are negatively related to short term interest rate at the varying significance levels. However, the remaining sector indices are insignificant. Studies that affirm the JSE Top 40 Index findings are Gupta and Reid (2012) and Hackland (2016) studies. Health Care Index result is consistent with studies by Ihsan *et al.* (2007), Junkin (2011), and Saeed (2012). Telecommunications Index results affirms with Ihsan *et al*. (2007), Saeed (2012) and Arnes (2014) studies.

In terms of the June 1995 to June 2007, only JSE Top 40 Index and Industrials Index (J520) are negatively related to short term interest rates, both at the 1% levels. Consumer Goods Index (J530), Telecommunications Index (J560) and Financials Index (J580) show no long run relationship with the inflation rate and the remaining indices are insignificant. Industrials Index results affirms with studies by Van Rensburg (1995), Gupta and Reid (2013) and Banda (2017). However, Gunsel and Cukur (2007) and Junkin (2011) found contradictory results.

The July 2007 to December 2018 sub period sector indices results show that the Telecommunications Index is negatively related to the short term interest rate at the 1% level. Technology Index is positively related at the 10% significance level. Basic Materials Index, Industrials Index, Consumer Goods Index and Consumer Services Index show no long run relationship with short term interest rate and the remaining indices are insignificant. Telecommunications Index finding is consistent with Saeed (2012) study. Technology Index finding is inconsistent with Arnes (2014) study.

These results have important implications. Firstly, during the post crisis period it shows that only two indices are impacted (Telecommunications Index and Technology Index) by short term interest rate whilst the remaining indices are insignificant. This is unsurprising as short-term interest rates have generally been lower post the global financial crisis. Companies have focused on reducing debt, thereby reducing their vulnerability to increases in interest rates or

the benefits of falling interest rates. Secondly, if investors wanted to gain from rising interest rate in the July 2007 to December 2018 sub period they needed to invest in the Technology Index. Technology Index increases by 7.94% as short term interest rate increased by 1 percentage point in the long run. However, if they wanted to hedge against rising interest rates, indices such as Consumer Goods Index, Consumer Services Index and Financials Index would have been favourable to invest in.

### 5.9.2 Short run

Table 10: Results of the short term interest rate and various indices in the short run

| **Time period** | **D(J200)** | **D(J203)** | **D(J510)** | **D(J520)** | **D(J530)** | **D(J540)** | **D(J550)** | **D(J560)** | **D(J580)** | **D(J590)** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Dec 2018** | -* | -* | -*** | -** | Na | -*** | -** | -* | -* | Na |
| **Jun 1995-Jun 2007** | -* | -* | -** | -** | -*** | -** | -* | -* | -* | Na |
| **Jul 2007- Dec 2018** | +** | Na | Na | Na | Na | Na | Na | +* | -** | +*** |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

The results in table 10 show that the short term interest rate is negatively related with the JSE All Share Index (J203) at the 1% levels for the full time period and the June 1995 to June 2007 sub period. However, the relationship for the July 2007 to December 2018 sub period for the All Share Index is insignificant. Studies like Jefferis and Okeahalam (2000) and Coetzee (2002), affirms the finding, however, Coovadia (2014) and Ndlovu *et al.* (2018) found a positive relationship

For the sector indices for the full time period, JSE Top 40 Index (J200), Basic Materials Index (J510), Industrials Index (J520), Health Care Index (J540), Consumer Services Index (J550), Telecommunications Index (J560) and Financials Index (J580) are negatively related to the short term interest rate at the varying significance levels. However, the Consumer Services Index (J530) and Technology Index (J590) are insignificant.

In terms of the June 1995 to June 2007 sub period, JSE Top 40 Index, Telecommunications Index, Consumer Services Index and Financials Index are all negatively related to short term interest rate at the 1% level. Basic Materials Index, Industrials Index and Health Care Index are all related at the 5% level. Consumer Goods Index is related at the 10% significance level. Only Technology Index is insignificant.

The July 2007 to December 2018 sub period results are very different from the earlier sub period. The Telecommunications Index, JSE Top 40 Index and Technology Index are now positively related to short term interest rate at the 1%, 5% and 10% levels, respectively. Only, Financials Index is negatively related at the 5% level. The remaining sector indices are insignificant. Telecommunications Index, JSE Top 40 Index and Financials Index are sector indices are which are significant in all periods but the signs of the first two indices change over the 2 sub periods.

These results have important implications. Firstly, the differences between the two sub periods suggest that the importance of short term interest rates for stock market performance has decreased post-2007 in the short run. This is not surprising, because as discussed previously in section 5.9.1, interest rates and firms' debt levels were lower in the second period.

If investors wanted to benefit from falls in interest rates, the JSE All Share Index was the best index to invest in in both sub periods as it is significantly negatively influenced by interest rates in both periods. In the post crisis period, the Technology Index has the highest responsiveness when interest rates increase. Technology Index increases by 5.03% as short term interest rate increases by 1 percentage point in the short run. However to hedge from changing interest rate in the post crisis period, indices such as Basic Materials Index, Industrials Index, Consumer Goods Index, just to name a few, would be favourable.

## 5.10 Impact of the real effective exchange rate on JSE All Share Index and sector indices

Tables 11 and 12 show the signs and significance level between the real effective exchange rate and various indices in the long run and short run, respectively.

### 5.10.1 Long run

Table 11: Results of the real effective exchange rate and various indices in the long run

| **Time period** | **J200** | **J203** | **J510** | **J520** | **J530** | **J540** | **J550** | **J560** | **J580** | **J590** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Dec 2018** | -** | -** | Na (NC) | Na | Na | Na | Na | Na | Na | Na |
| **Jun 1995-Jun 2007** | -* | -* | -* | Na | Na (NC) | Na | +* | Na (NC) | Na (NC) | Na |
| **Jul 2007- Dec 2018** | -** | -* | Na | Na | Na | -** | Na | Na | -** | Na |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (NC) | (NC) | (NC) | | (NC) | | | |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

The results in Table 11 show that the real effective exchange rate is negatively related to JSE All Share index (J203) at the 5%, 1% and 1% levels, for the whole time period, June 1995 to June 2007 and July 2007 to December 2018 sub periods, respectively. The negative relationship between real effective exchange rate and JSE All Share Index is consistent with *a priori* expectations. A weakening in the exchange rate makes it relatively cheaper for foreign investors to acquire equities and other assets in South Africa and increases their chances of significant capital gains should the exchange rate later recover some of its losses. Moreover, key components of the All Share and Top 40 Indices are companies that are dual listed on the JSE and overseas markets. Their prices are determined in foreign currency and therefore rise if the rand exchange rate weakens. In support of the findings local empirical evidence by Coetzee (2002), MacFarlane (2011), Ntshangase *et al.* (2016) and Ndlovu *et al.* (2018) found a negative relationship between the exchange rate and All Share Index. On the contrary, Jefferis and Okeahalam(2000) and Muchaonyerwa and Choga (2015) found a positive relationship.

For the full time period, June 1995 to December 2018, in terms of the sector indices, as shown in Table 11, also JSE Top 40 Index (J200) is negatively related to the real effective exchange rate at the 5% level. This finding is supported by the preponderance of dual-listed companies in the Top 40 and All Share Indices. JSE Top 40 Index results confirms with finding by Hackland (2016). Basic Materials Index has no long run relationship with the exchange rate and the remaining sector indices are insignificant.

In terms of the June 1995 to June 2007 sub period as shown in Table 11, JSE Top 40 Index and Basic Materials Index (J510) are both negatively related to the exchange rate at the 1% significance level, whilst Consumer Services Index (J550) is positively related at the 1% confidence level. Consumer Goods Index (J530), Telecommunications Index (J560) and Financials Index (J580) have no long run relationship with the exchange rate and the remaining sector indices are insignificant. Basic Materials Index finding are inconsistent with Gunsel and Cukur (2007), Hancocks (2010), Junkin (2011) and Ciftci (2014) studies. Consumer Services Index findings are consistent with Hancocks (2010), however, Junkin (2011) and Arnes (2014) found a negative relationship.

For the July 2007 to December 2018 sub period, JSE Top 40 Index, Health Care Index (J540) and Financials Index are negatively related to the real effective exchange rate 1%, 5% and 5% levels, respectively. Basic Materials Index, Industrials Index, Consumer Goods Index and Consumer Services Index have no long run relationship with the exchange rate. However, the remaining sector indices are insignificant. Health Care Index findings are consistent with Ihsan *et al.* (2007) and Jambotkar and AnjanaRaju (2018) studies. Financials Index results are consistent with Ihsan *et al.* (2007), Arnes (2014), Okech and Mugambi(2016) and Jambotkar and AnjanaRaju (2018) studies, however, Maysami *et al.* (2005) found a positive relationship.

These results have important implications. Firstly, for investors wanting to gain from weakness in the real effective rate, JSE All Share Index and JSE Top 40 Index are favourable indices in which to invest, as they are significantly negatively impacted by the exchange rate in all periods. Industrials Index, Consumer Goods Index, Telecommunications Index and Technology Index are the best indices to hedge against a strengthening real effective exchange rate as they are insignificantly related to the index in all periods.

Health Care Index has the highest responsiveness rate to changes in real effective exchange rate in the post crisis period as shown in appendix 5.18. Health Care Index decreases by -2.69% as exchange rate increases by 1% in the long run.

### 5.10.2 Short run

Table 12: Results of the real effective exchange rate and various indices in the short run

| **Time period** | **D(J200)** | **D(J203)** | **D(J510)** | **D(J520)** | **D(J530)** | **D(J540)** | **D(J550)** | **D(J560)** | **D(J580)** | **D(J590)** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Dec 2018** | Na | Na | Na | +* | Na | +* | +** | +* | +* | Na |
| **Jun 1995-Jun 2007** | Na | Na | Na | +*** | Na | Na | +** | Na | Na | Na |
| **Jul 2007- Dec 2018** | Na | +*** | Na | +* | Na | +* | Na | Na | +* | +* |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

The results in Table 12 show that for July 2007 to December 2018, the real effective exchange rate is positively related to JSE All Share Index (J200) at the 10% level in the short run. However, for the whole time period June 1995 to December 2018 and the June 1995 to June 2007 sub period it is insignificant. The positive relationship between real effective exchange rate and JSE All Share Index is inconsistent with economic theory. However, local studies to

affirm to such a relationship are Jefferis and Okeahalam (2000), Muchaonyerwa and Choga (2015). The positive relationship might be due to both the exchange rate and share prices benefiting from improved investor confidence once the impact of the global financial crisis had dissipated.

In terms of the sector indices, the whole period June 1995 to December 2018 shows that Industrials Index (J520), Health Care Index (J540), Telecommunications Index (J560) and Financials Index (J580) are positively related to the real effective exchange rate in the short term at the 1% level. Consumer Services Index (J550) is positively related at 5% level. However, the remaining indices are insignificant.

For the June 1995 to June 2007 sub period, Industrials Index and Consumer Services Index are positively related to real effective exchange rate in the short run at the 10% and 5% level, respectively. However, the remaining sector indices are insignificant. For the July 2007 to December 2018 sub period, Industrials Index, Health Care Index, Financials Index, Technology Index (J590) and Telecommunications Index are all positively related to the exchange rate at the 1% significance levels. However, the remaining sector indices are insignificant.

If investors want to benefit from a strengthening of the exchange rate in the short run, the Industrials Index is the best index as it impacted positively in all periods to changes in the real effective exchange rate. In the July 2007 to December 2018 sub period, Health Care Index has the highest responsiveness to changes in real effective exchange rate. Health Care Index increases by 0.56% as exchange rate increases by 1% in the short run as shown in Appendix 5.21. However, if investors want to hedge against weakening of the real effective rate in the short run, they need to invest in indices such JSE Top 40 Index, Basic Materials Index and Consumer Services Index which showed no relationship with the real effective exchange rate in the short run. These results are surprising given the findings of negative relationships in the long run. Also for JSE Top 40 Index to be insignificant and the JSE All Share Index to be statistically significant over the June 1995 to December 2018 is surprising given the dominance of Top 40 shares in the overall index.

### 5.11 Error Correction Model: Speed of adjustment coefficients

Table 13: ECM on various indices

| Time Period | Variables | D(J200) | D(J203) | D(J510) | D(J520) | D(J530) | D(J540) | D(J550) | D(J560) | D(J580) | D(J590) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jun 1995-Dec 2018** | ECM(-1) | -* | -* | Na (NC) | -* | -* | -* | -* | -* | -* | -* |
| **Jun1995-Dec 2007** | ECM(-1) | -* | -* | -* | -* | Na (NC) | -* | -* | Na (NC) | Na (NC) | -* |
| **Jul2007-Dec 2018** | ECM(-1) | -* | -* | Na (NC) | Na (NC) | Na (NC) | -* | Na (NC) | -* | -* | -* |

Author's computation from Eviews 10

Notes: (1) *, ** and *** denote significance at 1%, 5% and 10%, respectively; (2) Na Denotes not significant: (3) NC denotes not cointegrated (4) – or + denotes the sign of the coefficient

The results in Table 13 show that JSE All Share Index (J203), JSE Top 40 Index (J200), Health Care Index (J540) and Technology Index (J590) all have significant ECM values in all three periods.

In terms of the June 1995 to December 2018 period, shows the ECM coefficient of JSE Top 40 Index (-0.1212) in Appendix 5.19 suggests a low adjustment process. 12.12 percent of the disequilibrium of the previous month's shock adjusts back to the long-run equilibrium in the current month. The ECM coefficient for Technology Index (-0.0094), suggests a very low adjustment process. Only 0.94 percent of the disequilibrium of the previous month's shock adjusts back to the long-run equilibrium in the current month. JSE Top 40 Index has the highest adjustment process for the whole period, whilst, Technology Index has the lowest.

In terms of the June 1995 to June 2007 sub period in Appendix 5.20, all the ECM coefficients are negative and significant as required. ECM coefficient of Industrials Index (0.2405), suggests a moderate adjustment process with 24.05 percent of the disequilibrium of the previous month's shock adjusting back to the long-run equilibrium in the current month. ECM coefficient for Technology Index (-0.0159) again suggests a very low adjustment process. Only 1.59 percent of the disequilibrium of the previous month's shock adjusts back to the long-run equilibrium in the current month. Industrials Index has the highest adjustment process for the June 1995 to June 2007 sub period, whilst Technology Index has the lowest. Technology Index

findings for June 1995 to June 2007 sub period are similar to the whole period, June 1995 to December 2018 period.

In terms of the July 2007 to December 2018 sub period shown in Appendix 5.21, all the ECM coefficients are negative and significant as expected. ECM coefficient of JSE All Share Index (-0.1550), suggests a moderate adjustment process. 15.50 percent of the disequilibrium of the previous month's shock adjusts back to the long-run equilibrium in the current month. ECM coefficient for Health Care Index (-0.0412) suggests a very low adjustment process with just 4.12 percent of the disequilibrium of the previous month's shock adjusting back to the long-run equilibrium in the current month. JSE All Share Index has the highest adjustment process for the July 2007 to December 2018 sub period, whilst, Health Care Index has the lowest.

## 5.12 Applicability of Models to Policy Prescription (Diagnostics Tests)

It is important to note that even when heteroscedasticity and autocorrelation consistent (HAC)[8] robust standard error technique on the ARDL model is employed to correct for both heteroscedasticity and autocorrelation (Gujarati, 2018), some models still suffered from heteroscedasticity or autocorrelation (Industrials Index (J520), Consumer Goods Index (J530), Financials Index (J580) and Telecommunications Index (J560)).

### 5.12.1 Autocorrelation: LM test (p value)

In terms of the full period June 1995 to December 2018 as shown in Appendix 5.22 all the models do not suffer from autocorrelation except for Consumer Goods Index (J530). Appendix 5.23 shows that for the June 1995 to June 2007 sub period none of the indices have autocorrelation, however July 2007 to December 2018 sub period only Financials Index (J580) exhibit autocorrelation as shown in Appendix 5.24.

### 5.12.2 Heteroscedasticity: ARCH

For both periods, full time period June 1995 to December 2018 and June 1995 to June 2007 sub period as shown in Appendices 5.22 and 5.23 only Telecommunications Index (J560) has heteroscedasticity for both periods, whilst the remaining indices have homoscedasticity. In terms of the July 2007 to December 2018 as shown in Appendix 5.24, only Industrials Index

[8] HAC standard errors are preferable to White's standard errors because they correct for both autocorrelation and heteroscedasticity whereas White's standard errors correct only for heteroscedasticity (Gujarati, 2018).

(J520) and Financials Index (J580) suffer from heteroscedasticity whilst the remaining indices do not.

### 5.12.3 Normality: Jarque-Bera (p value)

Appendices 5.22 and 5.23 show that the full time period June 1995 to December 2018 and June 1995 to June 2007 sub period, respectively, all the indices are not normally distributed as the corresponding p-values are less than 5%. In terms of the July 2007 to December 2018 sub period, as shown in Appendix 5.24, the Consumer Goods Index (J530), Health Care Index (J540) and Technology Index (J590) are not normally distributed, however the remaining indices are normally distributed as the corresponding p values are greater than 5%.

This non-normality in the distribution could be explained because some of the predictor variables increased or decreased more than the rest in response to global events, such as the 2007 global financial crisis (Avgerinopoulou, 2018).

### 5.12.4 Stability Tests

In terms of the full period, June 1995 to December 2018, as shown in Appendix 5.22, the Consumer Goods Index (J530), Consumer Services Index (J550), Telecommunications Index (J560) and Technology Index (J590) passed the stability test as both CUSUM and CUMSQ tests are stable. However, the remaining indices are insignificant. Appendix 5.23 shows only Consumer Services Index (J550) is stable for both tests, whilst the remaining indices are not stable for the June 1995 to June 2007 sub period. For the July 2007 to December 2018 sub period as shown in Appendix 5.24, the JSE Top 40 Index (J200), Basic Materials Index (J510), Industrials Index (J520), Consumer Services Index (J550), Telecommunications Index (J560) and Technology Index (J590) are all stable, however the remaining indices are unstable.

## 5.13 Conclusion

**In terms of the long run**, the results show that coincident indicator is positively related to the significant indices in all three periods. In terms of inflation, the results show no relationship between the inflation rate and the various indices for both whole period and the June 1995 to June 2007 sub period. However, for the July 2007 to December 2018 sub period, JSE All Share Index and JSE Top 40 Index are negatively related to inflation. For the real effective exchange rate, in terms, JSE All Share Index and JSE Top 40 Index are negatively related to the exchange

rate for the whole period and both sub periods. For the June 1995 to June 2007 sub period, Basic Materials Index is also negatively related whilst, Consumer Services is positively related. In terms of the July 2007 to December 2018 sub period, Health Index and Industrials Index are now negatively related. In terms of the short term interest rate, results change across the different time periods. For the whole period, JSE All Share Index, JSE Top 40 Index, Health Care Index and Telecommunications Index are negatively related to interest rate. In terms of the June 1997 to June 2007 sub period, only JSE All Share Index and Industrials are negatively related to the short term interest rate. For the July 2007 to December 2018 sub period, only Telecommunications Index and Technology Index are negatively related.

**In terms of the short run**, over the whole period June 1995 to December 2018 the coincident indicator is positively related to JSE All Share Index, Top 40 Index, Industrials Index, Consumer Goods Index, Consumer Services Index, Telecommunications, Financials Index and Technology Index. For the June 1995 to December 2007 sub period, JSE All Share Index, Top 40 Index, Basic Materials Index, Industrials Index, Consumer Goods Services and Health Index are positively related to the coincident indicator. For the July 2007 to December 2018 sub period, JSE All Share Index, Top 40 Index, Consumer Goods Index and Technology Index are positively related in the short run. Inflation is not significantly related to any index in the whole period. In terms of the June 1995 to June 2007 sub period, Industrials Index and Financials Index are positively related to inflation. For the July 2007 to December 2018 sub period, Consumer Goods Index, Health Index and Consumer Services Index are negatively related to the inflation rate. The real effective exchange rate, in terms of the whole period June 1995 to December 2018 is positively related to Industrials Index, Health Care Index, Consumer Services Index, Telecommunications Index and Financials Index. In terms of the June 1995 to June 2007 sub period, only Industrials Index and Consumer Services Index are positively related to the exchange rate. For the July 2007 to December 2018 sub period, All Share Index, Industrials Index, Health Care Index, Financials Index and Technology Index are positively related. In terms of the short term interest rate, for the whole period June 1995 to December 2018, JSE All Share Index, Top 40 Index, Industrials Index, Health Care Index, Consumer Services Index, Telecommunications Index and Financials Index are negatively related to the interest rate. For the June 1995 to June 2007 sub period, only Technology Index is insignificant, whilst the remaining indices are all negatively related to the short term interest rate. In terms of the July 2007 to December 2018 sub period, Top 40 Index, Telecommunications Index and Technology Index are positively related to the interest rate,

whilst, only Financials Index is negatively related. In terms of the ECM coefficients, there are all negative and significant as expected in all study periods. Most of the dummy variables are insignificant in both the long and short run for all three periods. In terms of the dummy variables, most of the dummies did not have impact on the various sectors, hence no evidence of structural breaks. The best models should not suffer from non-normality, autocorrelation, heteroscedasticity and stability problems. The July 2007 to December 2018 sub period have indices which meet that criteria. These indices are JSE Top 40 Index, Basic Materials Index and Consumer Services Index.

These findings have important implications for investors wishing to benefit or hedge against expected changes in macroeconomic variables in South Africa. These implications have been discussed above and will be summarised in the chapter that follows.

# Chapter 6: SUMMARY, CONCLUSION AND RECOMMENDATIONS

In this chapter, the relationship between macroeconomic variables and the various macroeconomic indices, revealed by the econometric results of this study are summarised. Recommendations arising from the study are also discussed.

## 6.1 Summary and Conclusion

This dissertation analyses the impact of macroeconomic variables on various indices listed on the JSE. This was achieved by using monthly data from June 1995 to December 2018. The theories advanced earlier in the study, namely EMH, CAPM, ICAPM, PVM and the APT all suggest a relationship should exist between the macroeconomic variables and share returns. The macroeconomic variables used for the study were selected based on the APT which acknowledges several sources of risk that affect the expected return of a share. However, the model has its own setbacks, for instance no theoretical foundation for the macroeconomic variables that should be included in ascertaining risk-adjusted share returns and it does not indicate the number of macroeconomic variables that should be included in the model.

The study made use of the unit root tests to examine the series for stationarity. The ARDL model was used to analyse the long and short run relationships between the macroeconomic variables and various indices of the JSE. The error correction model (ECM) was used to reconcile the short run behaviour of economic variables with the long run behaviour.

In terms of the long run, the coincident indicator as a proxy for changes in domestic economic activity was found to be positively related to JSE All Share Index and JSE Top 40 Index in all three periods. In terms of inflation, the results show no relationship between inflation rate and the various indices for both whole period and June 1995 to June 2007 sub period. However for the July 2007 to December 2018 sub period, JSE All Share Index and JSE Top 40 Index are negatively related to inflation. In terms of the whole period June 1995 to December 2018 as well as the June 1995 to June 2007 and July 2007 to December 2018 sub periods, the results show that all JSE All Share Index and JSE Top 40 Index are negatively related to the exchange rate. Consumer Services is positively related to the exchange rate, but only for the June 1995 to June 2007 sub period. For the whole period, JSE All Share Index, JSE Top 40 Index, Health Index and Telecommunications Index are negatively related to short term interest rates. In terms of the June 1997 to June 2007 sub period, JSE All Share Index and Industrials Index are negatively related to the short term interest rate. For the July 2007 to December

2018 sub period, Telecommunications Index and Technology Index are negatively related.

In terms of the short run, the coincident indicator is positively related to JSE All Share Index, Top 40 Index and Consumer Goods Index for all 3 time periods examined. Inflation is not significantly related to any index in the whole period June 1995 to December 2018, but in the June 1995 to June 2007 sub period, Industrials Index and Financials Index are positively related to inflation and in the July 2007 to December 2018 sub period, Consumer Goods Index, Health Index and Consumer Services Index are negatively related to the inflation rate. For the whole period, the Industrials Index, Health Care Index, Consumer Services Index, Telecommunications Index and Financials Index are positively related to the real effective exchange rate. Only Industrials Index and Consumer Services Index are positively related to the exchange rate in the June 1995 to June 2007 sub period and in the July 2007 to December 2018 sub period, the All Share Index, Industrials Index, Health Care Index, Financials Index and Technology Index are positively related. In terms of the short term interest rate, for the whole period, JSE All Share Index, Top 40 Index, Industrials Index, Health Care Index, Consumer Services Index, Telecommunications Index and Financials Index are negatively related to the interest rate. For the June 1995 to June 2007 sub period, only Technology Index is insignificant and all other indices are negatively related to the interest rate. The results change for the July 2007 to December 2018 sub period, where the Top 40 Index, Telecommunications Index and Technology Index are positively related to the interest rate, whilst, only Financials Index is negatively related.

## 6.2 Recommendation

### 6.2.1 Policy

The results of the study evoke important policy implications. As the study reveals that an increase in the exchange rate overall has a positive impact on the various indices in the short run, however in the long run the real effective exchange rate overall has a negative impact on the indices, hence SARB must put in place appropriate policy measures to ensure the stability of the exchange rate. This may be done through the implementation of prudent monetary policy measures to maintain positive investor sentiment and confidence (Banda, 2017). In terms of the interest rate, the results show that short term interest rate to be significant in influencing the returns of the various indices of the JSE. Hence, it is important that the central bank

constantly re-evaluates the rationality of the prevailing Repo Rate by utilising other monetary policy tools (open market purchases), to maintain suitable interest rates. Inflation overall has no influence on the various indices and maybe it is because of the rise of enhanced tools for managing inflation rate risk like, for instance gold or inflation-linked bonds or general increase in inflation rate does not exceed the target band, hence repo rate will be left unchanged.

### 6.2.2 Investors

Firstly, due to the fact that certain indices are not affected during slow economic growth it will help investors find defensive sectors to invest in during times of financial crises in order to hedge their investments. Secondly, diversification and profit opportunities exist for investors due to the inconsistent effects each of the macroeconomic variables have across various sectors.

### 6.2.3 Further Research

A possible area in which the study may be extended is to investigate the influence that other foreign variables have on various sectors of JSE especially other economies like USA, China and Euro Countries. Future research could extend this study by employing more dummy variables especially for the post financial crisis in order to check if the structural breaks have influenced the sectors. In addition future research could extend this study by adding more domestic variables into the study.

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## APPENDIX

### Appendix 2.1: Developed (Aggregate) Empirical Evidences Summary

| Author | Country | Stock Variable | Macroeconomic Variables | Results | Methodology |
|---|---|---|---|---|---|
| | | | **Developed (Aggregate)** | | |
| **Avgerinopoulou (2018)** | UK | FTSE 100 index | Consumer price index | Na | Ordinary Least Squares (OLS) |
| | | | Exchange Rate | +ve | |
| | | | Treasury bills rate | Na | |
| | | | Unemployment rate | Na | |
| | | | Oil prices | +ve | |
| | | | Industrial production and GDP | +ve | |
| **Hsing and Hsieh (2012)** | Poland | Poland Stock Exchange | Industrial production | +ve | GARCH or ARCH model |
| | | | GDP | +ve | |
| | | | Nominal effective exchange rate | -ve | |
| | | | Treasury bills rate | -ve | |
| | | | Expected inflation rate | -ve | |
| | | | German Stock Market index | +ve | |
| | | | US Stock Market index | +ve | |
| | | | Euro government bond yield | -ve | |
| | | | Government borrowing | -ve | |
| | | | Money supply | +ve | |
| **Humpe and Macmillan (2009)** | US | S&P 500 | CPI | -ve | Johansen co-integration |
| | | | Industrial production | +ve | |
| | | | Money supply | Na | |
| | | | Long-term interest rate | -ve | |
| | Japan | NKY225 | CPI | Na | |
| | | | Industrial production | +ve | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Money supply | -ve | |
| | | | Long-term interest rate | Na | |
| **Jareño and Negrut (2016)** | US | Dow Jones | GDP | +ve | Pearson correlation |
| | | | Interest rate | -ve | |
| | | S&P 500 | Industrial production | +ve | |
| | | | Interest rate | -ve | |
| | | | Unemployment rate | -ve | |
| | | | CPI | na | |
| **Masuduzzaman (2012)** | Germany | DAX30 | CPI | +ve | Johansen co-integration |
| | | | Interest rates | +ve | |
| | | | Money supply | +ve | |
| | | | Industrial productions | +ve (long and short run) | |
| | United Kingdom | FTSE100 | CPI | -ve | |
| | | | Interest rates | -ve | |
| | | | Money Supply | -ve | |
| | | | Industrial productions | +ve (long and short run) | |
| **Nasseh and Strauss (2000)** | US | France Stock Exchange | Industrial Production | +ve | Johansen Cointegration |
| | | | Short-term Interest rate | +ve | |
| | | | Long-term Interest rate | -ve | |
| | | | Business surveys of Manufacturing Orders | na | |
| | | | Consumer Price Index | +ve | |
| | | | Germany's Short-term Interest rate | +ve | |
| | | | Germany's Industrial Production | +ve | |
| | | | Germany's stock prices | na | |
| | | Italy Stock Exchange | Industrial Production | +ve | |
| | | | Short-term Interest rate | +ve | |
| | | | Long-term Interest rate | -ve | |

| | | | |
|---|---|---|---|
| | | Business surveys of Manufacturing Orders | +ve |
| | | Consumer Price Index | +ve |
| | | Germany's Short-term Interest rate | +ve |
| | | Germany's Industrial Production | +ve |
| | | Germany's stock prices | +ve |
| | Netherlands Stock Exchange | Industrial Production | +ve |
| | | Short-term Interest rate | +ve |
| | | Long-term Interest rate | -ve |
| | | Business surveys of Manufacturing Orders | +ve |
| | | Consumer Price Index | +ve |
| | | Germany's Short-term Interest rate | +ve |
| | | Germany's Industrial Production | na |
| | | Germany's stock prices | +ve |
| | Switzerland Stock Exchange | Industrial Production | +ve |
| | | Short-term Interest rate | na |
| | | Long-term Interest rate | na |
| | | Business surveys of Manufacturing Orders | +ve |
| | | Consumer Price Index | +ve |
| | | Germany's Short-term Interest rate | +ve |
| | | Germany's Industrial Production | +ve |
| | | Germany's stock prices | +ve |
| | UK Stock Exchange | Industrial Production | +ve |
| | | Short-term Interest rate | +ve |
| | | Long-term Interest rate | -ve |
| | | Business surveys of Manufacturing Orders | +ve |

| | | | | | |
|---|---|---|---|---|---|
| | | | Consumer Price Index | +ve | |
| | | | Germany's Short-term Interest rate | +ve | |
| | | | Germany's Industrial Production | +ve | |
| | | | Germany's stock prices | +ve | |
| | | Germany Stock Exchange | Industrial Production | +ve | |
| | | | Short-term Interest rate | +ve | |
| | | | Long-term Interest rate | -ve | |
| | | | Business surveys of Manufacturing Orders | +ve | |
| | | | Consumer Price Index | +ve | |
| **Ratanapakorn and Sharma (2007)** | US | S&P 500 | Long-term interest rate | -ve (Long run) | Johansen cointegration |
| | | | Inflation | +ve (Long run) | |
| | | | Money supply | +ve (long run) | |
| | | | Exchange Rate | +ve (long run) | |
| | | | Short term interest rate | +ve (long run) | |
| | | | Industrial production | +ve (long run) | |
| **Talla (2013)** | Sweden | (OMXS30) | Exchange Rate | -ve | Multivariate Regression |
| | | | CPI | -ve | |
| | | | Intrest rate | na | |
| | | | Money supply | na | |

## Appendix 2.2: Developed (Sector Indices) Empirical Evidences Summary

| Author | Country | Stock Variable | Macroeconomic Variables | Results | Methodology |
|---|---|---|---|---|---|
| | | | **Developed(Sub sectors)** | | |
| **Çiftçi (2014)** | US | Basic Materials | **Full period results** | | Ordinary least squares (OLS) |
| | | | Oil prices | +ve | |
| | | | T-bills(short term interest rate) | na | |
| | | | Exchange rate | +ve | |
| | | | Gold | na | |
| | | | **Sub period 1** | | |
| | | | Oil prices | +ve | |
| | | | T-bills(short term interest rate) | na | |
| | | | Exchange rate | na | |
| | | | Gold | na | |
| | | | **Sub period 2** | | |
| | | | Oil prices | na | |
| | | | T-bills(short term interest rate) | na | |
| | | | Exchange rate | na | |
| | | | Gold | na | |
| | | Consumer Goods | **Full period** | | |
| | | | Oil prices | na | |
| | | | T-bills(short term interest rate) | na | |
| | | | Exchange rate | +ve | |
| | | | Gold | na | |
| | | | **Sub period 1** | | |
| | | | Oil prices | -ve | |
| | | | T-bills(short term interest rate) | na | |
| | | | Exchange rate | na | |
| | | | Gold | na | |

| | | | |
|---|---|---|---|
| | | **Sub period 2** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | Consumer Services | **Full period results** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | -ve |
| | | **Sub period 1** | |
| | | Oil prices | -ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | | **Sub period 2** | |
| | | Oil prices | +ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | -ve |
| | Financials | **Full period results** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | | **Sub period 1** | |
| | | Oil prices | -ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |

| | | | |
|---|---|---|---|
| | | Gold | -ve |
| | | **Sub period 2** | |
| | | Oil prices | +ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | -ve |
| | Healthcare | **Full period results** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | | **Sub period 1** | |
| | | Oil prices | -ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | | **Sub period 2** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | Industrials | **Full period results** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | -ve |
| | | **Sub period 1** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |

| | | | |
|---|---|---|---|
| | | Exchange rate | na |
| | | Gold | na |
| | | **Sub period 2** | |
| | | Oil prices | +ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | -ve |
| | Oil and Gas | **Full period results** | |
| | | Oil prices | +ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | | **Sub period 1** | na |
| | | Oil prices | +ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | | **Sub period 2** | |
| | | Oil prices | +ve |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | Technology | **Full period results** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | +ve |
| | | Gold | -ve |
| | | **Sub period 1** | |
| | | Oil prices | na |

| | | | |
|---|---|---|---|
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | +ve |
| | | Gold | na |
| | | **Sub period 2** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | Telecommunications | **Full period results** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | -ve |
| | | **Sub period 1** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | +ve |
| | | Gold | na |
| | | **Sub period 2** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | Utilities | **Full period results** | |
| | | Oil prices | na |
| | | T-bills(short term interest rate) | na |
| | | Exchange rate | na |
| | | Gold | na |
| | | **Sub period 1** | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Oil prices | na | |
| | | | T-bills(short term interest rate) | na | |
| | | | Exchange rate | na | |
| | | | Gold | na | |
| | | | **Sub period 2** | | |
| | | | Oil prices | na | |
| | | | T-bills(short term interest rate) | na | |
| | | | Exchange rate | na | |
| | | | Gold | na | |
| **Gunsel and Cukur (2007)** | London | Construction, food, beverage and tobacco, oil exploration and production, electronic and electrical equipment sectors | Term Structure of Interest Rates | +ve | OLS |
| | | Food, beverage and tobacco sectors | Unanticipated Inflation | -ve | |
| | | Food, beverage and tobacco and engineering sectors | Unanticipated Industrial Production | -ve | |
| | | Chemical sector | Real Exchange Rate | +ve | |
| | | Building materials and merchants and engineering sectors | Real Exchange Rate | -ve | |
| | | Construction, food, beverage and tobacco, oil exploration and production, electronic and electrical equipment sectors | Interest rate | +ve | |
| | | Building, materials, merchants, food, beverage and tobacco sectors | Money Supply | +ve | |
| | | Household goods and textiles | Money Supply | -ve | |
| **Maysami *et al.* (2005)** | China | Singapore stock market index | CPI | +ve | Engle Granger or Johansen |
| | | | Industrial production | +ve | |

| | | | | | |
|---|---|---|---|---|---|
| | | | 1-year inter-bank rates | -ve | |
| | | | 3-month inter-bank offer rate | +ve | |
| | | | Money supply | +ve | |
| | | | Exchange rate | +ve | |
| | | Finance index | CPI | +ve | |
| | | | Industrial production | na | |
| | | | 1-year inter-bank rates | -ve | |
| | | | 3-month inter-bank offer rate | +ve | |
| | | | Money supply | +ve | |
| | | | Exchange rate | +ve | |
| | | Property index | CPI | +ve | |
| | | | Industrial production | +ve | |
| | | | 1-year inter-bank rates | -ve | |
| | | | 3-month inter-bank offer rate | +ve | |
| | | | Money supply | +ve | |
| | | | Exchange rate | +ve | |
| | | Hotel index | CPI | -ve | |
| | | | Industrial production | +ve | |
| | | | 1-year inter-bank rates | na | |
| | | | 3-month inter-bank offer rate | na | |
| | | | Money supply | -ve | |
| | | | Exchange rate | -ve | |
| **Zhu (2012)** | China | Shanghai Energy stock market | Inflation rate | na | OLS |
| | | | Money supply | na | |
| | | | Exchange rate | +ve | |
| | | | Industrial production | +ve | |
| | | | Bond | na | |
| | | | Exports | -ve | |

| | | |
|---|---|---|
| | Imports | na |
| | Foreign reserve | +ve |
| | Unemployment rate | +ve |

## Appendix 2.3: Developing (Aggregate) Empirical Evidences Summary

| Author | Country | Stock Variable | Macroeconomic Variables | Results | Methodology |
|---|---|---|---|---|---|
| | | | Developing(Aggregate) | | |
| **Abdulrahim (2011)** | Nigeria | Nigerian Stock Exchange | Industrial production | na | Ordinary least square estimation |
| | | | Interest rate | -ve | |
| | | | Inflation | -ve | |
| | | | Exchange rate | na | |
| | | | Money supply | +ve | |
| **Abraham (2011)** | Nigeria | Nigerian All Share Index | Inflation | na | Error correction model |
| | | | Minimum rediscounting rate | -ve(short run) | |
| | | | Exchange rates | na(short run)/-ve(long run) | |
| | | | T-bills(short term interest rate) | na | |
| **Acquah (2014)** | Ghana | Ghanaian Stock Market | Economic activity | +ve | Vector Autoregression (VAR) Model |
| | | | Global commodity price index | -ve | |
| | | | Inflation | +ve | |
| | | | Interest rates | -ve | |
| **Adam and Tweneboah (2008)** | Ghana | Databank Stock Index | Inward foreign direct investments | -ve(long run) | Johansen's co-integration |
| | | | Treasury bill rate | +ve (long run)/-ve(short run) | |
| | | | Consumer price index | -ve(long and short run) | |
| | | | Exchange rate | +ve(long run)/-ve(short run) | |
| **Adesanmi (2018)** | Nigeria | Mexico Stock Exchange | Commodity price index | -ve(long run)/+ve(short run) | ARDL |
| | | | Exchange rate | -ve(long and short run) | |
| | | | Interest rate | +ve(long and short run) | |

| | | | |
|---|---|---|---|
| | | Industrial production | na (long and short run) |
| | | Morgan Stanley Capital International (MSCI) | +ve(long run and short run) |
| | | Federal Fund Rate | na(long and short run) |
| | Indonesia Stock Exchange | Commodity price index | na(long and short run) |
| | | Exchange rate | +ve(long run)/na(short run) |
| | | Interest rate | -ve(long run)/-ve short run |
| | | Industrial production | na(long and short run) |
| | | Morgan Stanley Capital International (MSCI) | +ve(long and short run) |
| | | Federal Fund Rate | na(long and short run) |
| | Nigeria Stock Exchange | Commodity price index | na(long run)/ na short run |
| | | Exchange rate | +ve(long run)/ na short run |
| | | Interest rate | +ve(long run)/na(short run) |
| | | Industrial production | +ve(long run)/na (short run) |
| | | Morgan Stanley Capital International (MSCI) | +ve(long run and short run) |
| | | Federal Fund Rate | -ve(long and short run) |
| | | Oil Price | na(long and short run) |
| | Turkey Stock Exchange | Commodity price index | na(long and short run) |
| | | Exchange rate | na(long and short run) |
| | | Interest rate | -ve(long run)/-ve short run |

| | | | | | |
|---|---|---|---|---|---|
| | | | Industrial production | na(long run)/ -ve(short run) | |
| | | | Morgan Stanley Capital International (MSCI) | +ve(long and short run) | |
| | | | Federal Fund Rate | -ve(long run)/ na (short run) | |
| **Büyükşalvarcı, (2010)** | Turkish | Istanbul Stock Exchange Index-100 | Interest rate | -ve | Regression Analysis |
| | | | Industrial production index | -ve | |
| | | | Oil price | -ve | |
| | | | Foreign exchange rate | -ve | |
| | | | Money supply | +ve | |
| | | | Inflation | na | |
| | | | Gold price | na | |
| **Dasgupta (2012)** | India | BSE SENSEX | Wholesale price index(proxy for CPI) | -ve(long run) | Johansen and Juselius |
| | | | Index of industrial production | +ve(long run) | |
| | | | Exchange rate | -ve(long run) | |
| | | | Call money rate | +ve(long run) | |
| **Firat (2013)** | Turkey | BIST 100 index | S&P 500 index | +ve | Regression Analysis |
| | | | Trade volume | +ve | |
| | | | Industrial production index | -ve | |
| | | | Foreign exchange rate | na | |
| | | | Interest rate on short term government bonds | +ve | |
| **Hsing (2011)** | Czech | Czech stock market index | Real GDP | +ve | Exponential GARCH |
| | | | US Stock Market index | +ve | |
| | | | German Stock Market index | +ve | |
| | | | Government borrowing to GDP | -ve | |
| | | | Domestic real interest rate | -ve | |
| | | | Exchange rate | -ve | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Expected inflation rate | -ve | |
| | | | euro area government bond yield | -ve | |
| | | | M2/GDP | -ve/+ve | |
| **Ibrahim and Musah (2014)** | Ghana | Ghana Stock Exchange | Exchange Rate | -ve(long run and short run) | Johansen cointegration |
| | | | Interest Rate (INTR) | na | |
| | | | Inflation (INFL) | +ve (long run) | |
| | | | Money Supply | +ve (long run) | |
| | | | Industrial Production | -ve (long run ) | |
| **Khalid and Khan (2017)** | Pakistan | KSE-100 index | Interest rates | -ve (short and long run) | Autoregressive Distributed Lag (ARDL) bounds |
| | | | Exchange rate | na | |
| | | | Inflation rates | +ve (long run) | |
| **Kirui *et al.* (2014)** | Kenya | Nairobi Securities Exchange Limited | Gross Domestic Product | na | TGARCH |
| | | | Treasury bill rate | na | |
| | | | Exchange rate | +ve | |
| | | | Inflation | na | |
| **Kitati *et el.* (2015)** | Kenya | Nairobi Securities Exchange | Foreign exchange rate | -ve | Multi-variate regressions analysis |
| | | | Interest rate | -ve | |
| | | | Inflation rate | -ve | |
| **Kuwornu and Owusu - Nantwi (2011)** | Ghana | Ghana Stock Exchange | Consumer price index | +ve | Ordinary least square estimation |
| | | | Crude oil price | na | |
| | | | Exchange rate | na | |
| | | | 91 day Treasury bill rate | na | |
| **Makatchaya (2014)** | Malawi | Malawi Stock Exchange | Exchange rate | +ve | GARCH |
| | | | Interest rate | -ve | |
| **Naik and Padhi (2012)** | India | BSE Sensex | Industrial production index | +ve (long run) | Johansen's co-integration |
| | | | Wholesale price index | -ve | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Money supply | +ve (long run) | |
| | | | Treasury bills rates | na | |
| | | | Exchange rates | na | |
| **Ozbay (2009)** | Turkey | Turkey Stock Exchange | Interest rate | -ve | Granger causality test |
| | | | Inflation | na | |
| | | | Exchange rates | na | |
| | | | Money supply | na | |
| | | | Industrial production index | na | |
| **Rafay *et al*. (2014)** | Pakistan | KSE 100 index | Interest rate | na | Regression Analysis |
| | | | Exchange rate | na | |
| | | | Consumer price index | na | |
| | | | Imports | +ve | |
| | | | Exports | na | |
| **Sohail and Hussain (2009)** | Pakistan | Lahore Stock Exchange | CPI | -ve (long run) | Johansen's co-integration |
| | | | Industrial Production | +ve (long run) | |
| | | | Real Effective Exchange Rate | +ve (long run) | |
| | | | Money supply | +ve (long run) | |
| **Songole (2012)** | Kenya | Nairobi Stock Exchange | Consumer price index | -ve | Regression Analysis |
| | | | Market interest rate | -ve | |
| | | | Industrial Production Index | +ve | |
| | | | Foreign exchange rate | -ve | |
| **Tangjitprom, (2011)** | Thailand | Thailand stock exchange | Unemployment rate | na | Regression Analysis |
| | | | Five-year government bond yield | -ve | |
| | | | CPI | na | |
| | | | Exchange rate | -ve | |
| **Yurdakul and Akcoraoglu (2005)** | Turkey | Istanbul Stock Exchange index | Exchange rate | -ve(long run) | Residual-based cointegration model |
| | | | Money supply | +ve(long run) | |
| | | | Real economic activity | +ve(long run) | |

## Appendix 2.4: Developing (Sector Indices) Empirical Evidences Summary

| Author | Country | Stock Variable | Macroeconomic Variables | Results | Methodology |
|---|---|---|---|---|---|
| | | **Developing(sub period)** | | | |
| **Al- Shubiri (2010)** | Jordan | 14 listed commercial banks in Amman Stock Exchange | Net Asset Value per Share | +ve | Regression Analysis |
| | | | Dividend percentage | +ve | |
| | | | Earnings per Share | +ve | |
| | | | Lending interest rate | na | |
| | | | Inflation rate | -ve | |
| | | | Gross Domestic Product | +ve | |
| **Arnes (2014)** | Turkey | XU100 National index | **Whole period** | | Ordinary Least Square (OLS) |
| | | | Turkish Real Effective Exchange Rate | +ve | |
| | | | USD to Turkish Lira Nominal Exchange Rate | na | |
| | | | Turkish Industrial Production | na | |
| | | | Inflation | na | |
| | | | Turkish Interbank Lending Rate | -ve | |
| | | | **Sub period 1** | | |
| | | | Turkish Real Effective Exchange Rate | na | |
| | | | USD to Turkish Lira Nominal Exchange Rate | na | |
| | | | Turkish Industrial Production | na | |
| | | | Inflation | na | |
| | | | Turkish Interbank Lending Rate | -ve | |
| | | | **Sub period 2** | | |
| | | | Turkish Real Effective Exchange Rate | na | |
| | | | USD to Turkish Lira Nominal Exchange Rate | -ve | |

| | | | |
|---|---|---|---|
| | | Turkish Industrial Production | na |
| | | Inflation | na |
| | | Turkish Interbank Lending Rate | -ve |
| | Financial | **Sub period 2** | |
| | | Turkish Real Effective Exchange Rate | na |
| | | USD to Turkish Lira Nominal Exchange Rate | -ve |
| | | Turkish Industrial Production | na |
| | | Inflation | na |
| | | Turkish Interbank Lending Rate | na |
| | Industrials | **Sub period 2** | |
| | | Turkish Real Effective Exchange Rate | na |
| | | USD to Turkish Lira Nominal Exchange Rate | -ve |
| | | Turkish Industrial Production | na |
| | | Inflation | na |
| | | Turkish Interbank Lending Rate | na |
| | Services | **Sub period 2** | |
| | | Turkish Real Effective Exchange Rate | -ve |
| | | USD to Turkish Lira Nominal Exchange Rate | -ve |
| | | Turkish Industrial Production | na |
| | | Inflation | na |
| | | Turkish Interbank Lending Rate | na |
| | Technology | **Sub period 2** | |
| | | Turkish Real Effective Exchange Rate | na |
| | | USD to Turkish Lira Nominal Exchange Rate | -ve |

| | | | | | |
|---|---|---|---|---|---|
| | | | Turkish Industrial Production | na | |
| | | | Inflation | na | |
| | | | Turkish Interbank Lending Rate | -ve | |
| **Garba (2014)** | Nigeria | Listed Manufacturing Firms on the Nigeria Stock Exchange | Inflation rate | na | Multiple regressions |
| | | | Interest rate | na | |
| | | | Exchange rate of domestic currency | na | |
| | | | Gross national income | na | |
| **Gatuhi (2015)** | Kenya | Agriculture sector | Exchange rate | +ve | Analysis of Variance |
| | | | Interest rates | +ve | |
| | | | Inflation | -ve | |
| | | | Money Supply | +ve | |
| **Jambotkarl and AnjanaRaju (2018)** | India | Nifty Auto, Bank, IT, Financial service, PSU Bank, FMCG, Private bank and Pharma Indices | Exchange rate | -ve | Ordinary least square model |
| | | Nifty Energy Index | Exchange rate | +ve | |
| | | Nifty Auto | Bank rate | -ve | |
| | | Nifty Financial service and Private bank | Inflation | -ve | |
| | | Nifty Energy | Inflation | +ve | |
| **Ihsan *et al.* (2007)** | Pakistan | Cotton and Textile, Fuel and Energy, Transport and Communication and Banks and other Financial Institutions | GDP | -ve | Non-linear Regression |
| | | Cotton and Textile, Chemicals and Pharmaceutical, Paper and Board, Cement, Transport and Communication and Banks and other Financial Institutions | Inflation(Whole Price Index) | -ve | |
| | | Chemicals and Pharmaceutical, Fuel and Energy and Banks and other Financial Institutions | Interest rate | -ve | |
| | | Cotton and Textile, Sugar and Allied, Fuel and Energy and Banks and other Financial Institutions | Exchange rate | -ve | |

| | | | | | |
|---|---|---|---|---|---|
| **Izedonmi and Abdullahi (2011)** | Nigeria | 20 sectors of the Nigerian Stock Exchange | Inflation | na | Ordinary Least Square |
| | | | Exchange rate | na | |
| | | | Market capitalization | na | |
| **Okech and Mugambi (2016)** | Kenya | Listed banks in the Nairobi Securities Exchange | Exchange rate | -VE | OLS |
| | | | Interest rate | -VE | |
| | | | Inflation | +VE | |
| | | | GDP | NA | |
| **Owino (2014)** | Kenya | Nairobi Securities Exchange's 20-share index | Kenya's 91-day Treasury bill rate | -ve(short run)/+ve(long run) | Johansen's cointegration |
| | | | EU's inflation rate | na(long and short run) | |
| | | | EU's money supply | +ve(short run)/-ve (long run) | |
| | | | Industrial production index | +ve(short and long run) | |
| | | | FTSE 100 index | +ve(short run)/ -ve(long run) | |
| **Ozcan (2012)** | Turkey | Istanbul Stock Exchange (ISE) industry index | Interest rates | | Johansen's cointegration |
| | | | Consumer price index | | |
| | | | Money supply | -ve (long run) | |
| | | | Exchange rate | -ve (long run) | |
| | | | Gold prices | | |
| | | | Oil prices | | |
| | | | Current account deficit | | |
| | | | Export volume | | |
| **Saeed (2012)** | Pakistan | Textile composite, Cement, Cable and electrical Goods, Automobile, Chemical and Pharmaceutical, Leasing and Glass and Ceramics | Interest rate | -ve | Ordinary Least Square |
| | | Automobiles and Cable and Electronics | Exchange rate | -ve | |
| | | Textile composite | Exchange rate | +ve | |

| | | | |
|---|---|---|---|
| | Textile composite, Cement, Cable and electrical Goods, Automobile, Chemical and Pharmaceutical, Leasing and Glass and Ceramics, Jute and Oil and Gas | Industrial Production | na |
| | Cable and Electronics | Money Supply | -ve |

## Appendix 2.5: South Africa (Aggregate) Empirical Evidences Summary

| Author | Country | Stock Variable | Macroeconomic Variable | Results | Methodology |
|---|---|---|---|---|---|
| | | | **South Africa (Aggregate Indices)** | | |
| **Beukes (2009)** | South Africa | JSE All Share Index | Inflation | -ve | Ordinary Least Squares |
| | | | Exchange rate | na | |
| | | | GDP | na | |
| | | | Interest rate | +ve | |
| **Coetzee (2002)** | South Africa | JSE All Share Index | Inflation | -ve(short and long run) | Johansen Cointegration |
| | | | Exchange rate | -ve (short and long run) | |
| | | | Interest rate | -ve (short and long run) | |
| | | | GDP | -ve | |
| **Coovadia (2014)** | South Africa | JSE All Share Index | Inflation | +ve(long and short run) | Vector Error Correction Model |
| | | | Short-term interest rate | na (long run)/ +ve (short run) | |
| | | | Long-term interest rate | na (short and long run) | |
| | | | Foreign exchange rate | na (short and long run) | |
| | | | Money supply | -ve(long run)/ +ve (short run) | |
| | | | Industrial production | na (long and short run) | |
| | | | Gross Domestic Product (GDP) | +ve(long and short run) | |
| | | | Oil price | na (long and short run) | |
| | | | Gold price | Na (long and short run) | |
| **Jefferis and Okeahalam (2000)** | South Africa | JSE All Share Index | Exchange rate | +ve(long and short run) | Johansen multivariate cointegration, |
| | | | Foreign GDP | na (long run and short) | |
| | | | Domestic GDP | +ve(long and short run) | |
| | | | Domestic interest rate | -ve(long and short run) | |
| | | | Foreign interest rates | -ve (short and long run) | |

| | | | | | |
|---|---|---|---|---|---|
| **Moores-Pitt (2018)** | South Africa | JSE All Share Index | Inflation | +ve | Johansen's cointegration |
| **Moores-Pitt and Strydom (2017)** | South Africa | JSE All Share Index | Inflation | +ve | Johansen's cointegration |
| **Muchaonyerwa and Choga (2015)** | South Africa | JSE All Share Index | Real Effective Exchange Rate | +ve | Correlation |
| | | | Money Supply | +ve | |
| | | | Inflation | +ve | |
| | | | Prime Overdraft Rate | -ve | |
| | | | Business cycle coincident indicator | +ve | |
| **Ndlovu *et al.* (2018)** | South Africa | JSE All Share Index | Money supply | +ve (long run)/ na (short run) | co-integration tests |
| | | | Interest rates | +ve (long and short run) | |
| | | | Inflation | +ve(long run)/ na (short run) | |
| | | | Exchange rate | -ve(long run )/ +ve (short run) | |
| | | | GDP | -ve | |
| **Ntshangase *et al.* (2016)** | South Africa | JSE All Share Index | Money supply | -ve(long run)/ +ve (short run) | Johansen cointegration test and VAR model |
| | | | Interest rate | -ve(long run)/ na(short run) | |
| | | | Inflation | +ve (long run)/ -ve (short run) | |
| | | | Exchange rate | -ve (long run)/ na (short run) | |
| | | | Government expenditure | -ve(long run)/ +ve (short run) | |
| **Olalere (2006)** | South Africa | JSE All Share Index | Consumer price index | -ve | cointegration and error correction |
| | | | Rand-dollar real exchange rates | Na | |
| | | | Domestic GDP | na | |
| | | | Yield on South African government bonds | na | |

| | | |
|---|---|---|
| | Yield on United States government bonds | -ve |
| | United States GDP | na |

## Appendix 2.6: South Africa (Sector indices) Empirical Evidences Summary

| Author | Country | Stock Variable | Macroeconomic Variables | Results | Methodology |
|---|---|---|---|---|---|
| | | | **South Africa (Sub Sector Indices)** | | |
| **Afordofe (2011)** | South Africa | Resource Index | GDP | +ve | Correlation |
| | | | Inflation | inconclusive | |
| | | | Interest rates | -ve | |
| | | | Rand/US Dollar Exchange Rate | +ve | |
| **Banda (2017)** | South Africa | Industrial 25 Index | GDP | Na(long run and short run) | Johansen Cointegration |
| | | | Inflation | +ve (long run)/ na (short run) | |
| | | | Prime rate | -ve(long run)/ na (short run) | |
| | | | Exchange rate | na( long and short run) | |
| **Gupta and Reid (2013)** | South Africa | All Share (ALSI),Top 40,Mining, Financials, Financials and industries, General industrials, Basic industrials, Resources and Retailers index, Gold mining | Gross domestic product | na | VAR |
| | | | Producer price index | na | |
| | | | Current account | na | |
| | | | Repo | -ve (for all indices) | |
| | | | Inflation | -ve (only for Gold) | |
| | | Gold mining | Gross domestic product | na | |
| | | | Consumer price index | -ve | |

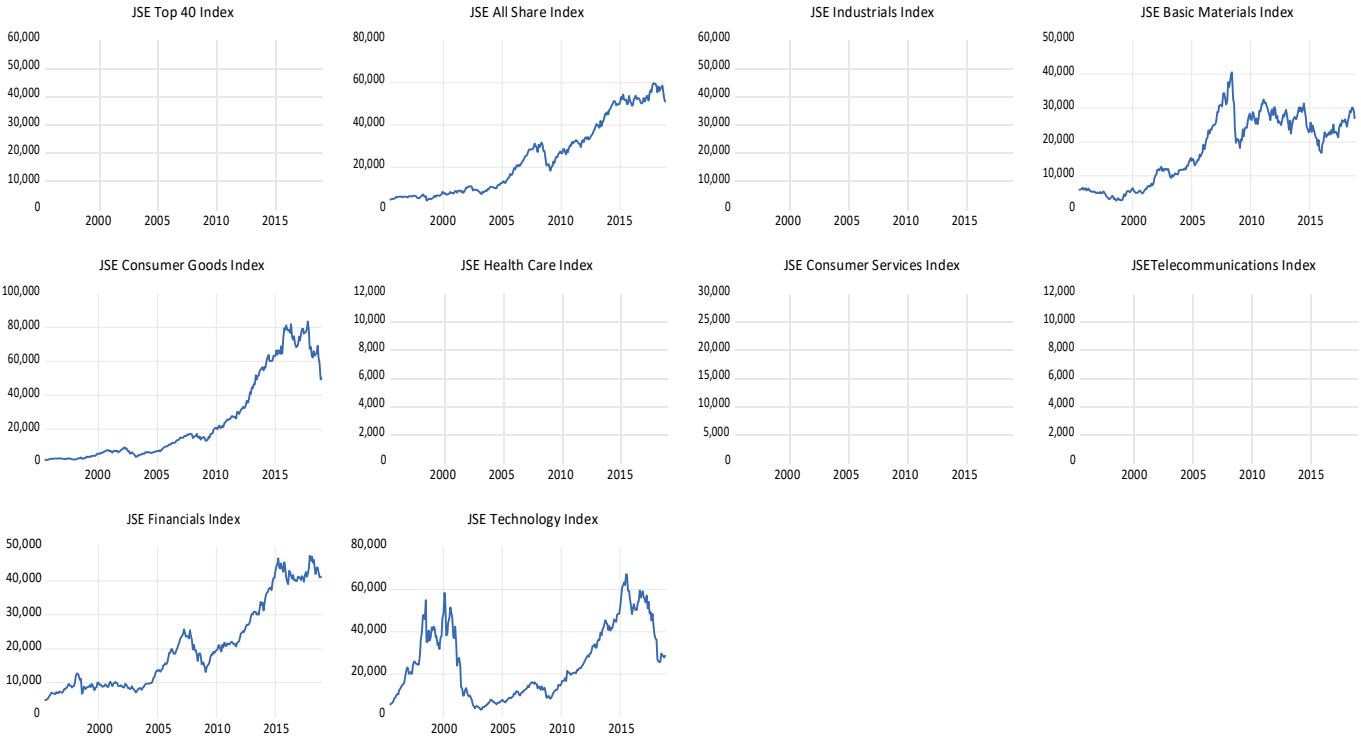
| | | | | | |
|---|---|---|---|---|---|
| | | | Producer price index | na | |
| | | | Current account | na | |
| | | | Repo | -ve | |
| **Hackland (2016)** | South Africa | Top 40 | Interest rate | -ve | correlation |
| | | | GDP | na | |
| | | | Inflation | -ve | |
| | | | Exchange rate | -ve | |
| | | Resource 10 | Interest rate | -ve | |
| | | | GDP | na | |
| | | | Inflation | -ve | |
| | | | Exchange rate | na | |
| | | Industrial 25 | Interest rate | na | |
| | | | GDP | +ve | |
| | | | Inflation | na | |
| | | | Exchange rate | -ve | |
| | | Financial 15 | Interest rate | -ve | |
| | | | GDP | +ve | |
| | | | Inflation | na | |
| | | | Exchange rate | -ve | |
| **Hancock (2010)** | South Africa | All-Share | Money supply | +ve | Johansen cointegration |
| | | | Inflation | -ve | |
| | | | Long interest rate | na | |
| | | | Short- run interest rate | -ve | |
| | | | Exchange rate | -ve | |
| | | Financial | Money supply | +ve | |
| | | | Inflation | -ve | |
| | | | Long interest rate | -ve | |
| | | | Short- run interest rate | -ve | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Exchange rate | -ve | |
| | | Mining | Money supply | +ve | |
| | | | Inflation | na | |
| | | | Long interest rate | +ve | |
| | | | Short- run interest rate | na | |
| | | | Exchange rate | +ve | |
| | | Retail Index | Money supply | na | |
| | | | Inflation | +ve | |
| | | | Long interest rate | +ve | |
| | | | Short- run interest rate | na | |
| | | | Exchange rate | +ve | |
| **Junkin (2011)** | South Africa | JSE All Share Index | Inflation | -ve | Johansen cointegration |
| | | | SA Industrial production | na | |
| | | | Nominal exchange rate | +ve | |
| | | | Foreign GDP | na | |
| | | | Interest rate | +ve | |
| | | Construction and Materials Index | Inflation | -ve | |
| | | | SA Industrial production | na | |
| | | | Nominal exchange rate | -ve | |
| | | | Foreign GDP | -ve | |
| | | | Interest rate | -ve | |
| | | Financial Index | Inflation | -ve | |
| | | | SA Industrial production | -ve | |
| | | | Nominal exchange rate | na | |
| | | | Foreign GDP | -ve | |
| | | | Interest rate | na | |
| | | Food Producers Index | Inflation | na | |
| | | | SA Industrial production | +ve | |

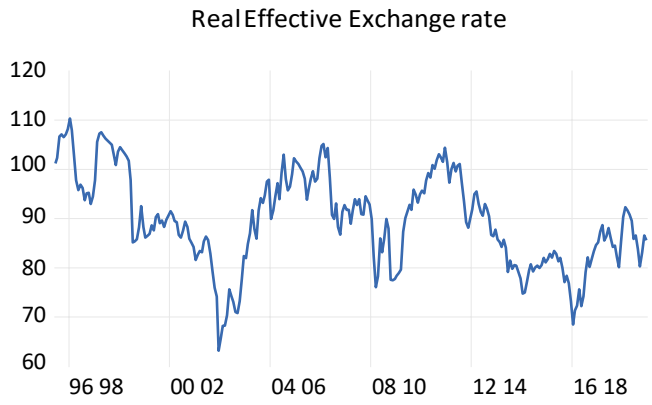
| | | | | | |
|---|---|---|---|---|---|
| | | | Nominal exchange rate | -ve | |
| | | | Foreign GDP | -ve | |
| | | | Interest rate | na | |
| | | General Retail Index | Inflation | +ve | |
| | | | SA Industrial production | +ve | |
| | | | Nominal exchange rate | -ve | |
| | | | Foreign GDP | -ve | |
| | | | Interest rate | na | |
| | | Industrial Index | Inflation | +ve | |
| | | | SA Industrial production | +ve | |
| | | | Nominal exchange rate | na | |
| | | | Foreign GDP | na | |
| | | | Interest rate | +ve | |
| | | Mining Index | Inflation | na | |
| | | | SA Industrial production | +ve | |
| | | | Nominal exchange rate | +ve | |
| | | | Foreign GDP | -ve | |
| | | | Interest rate | +ve | |
| | | Pharmaceuticals Index | Inflation | -ve | |
| | | | SA Industrial production | -ve | |
| | | | Nominal exchange rate | na | |
| | | | Foreign GDP | +ve | |
| | | | Interest rate | +ve | |
| **Van Rensburg (1995)** | South Africa | All Share, All God and Mining-Financial Indices | Unanticipated percentage changes in the (rand) gold price | +ve | Regression Analysis |
| | | | Unanticipated returns on the Dow-Jones industrial index | +ve | |
| | | | Unanticipated changes in inflation expectations | -ve | |
| | | | Unanticipated changes in the term structure ofinterest rates | -ve | |

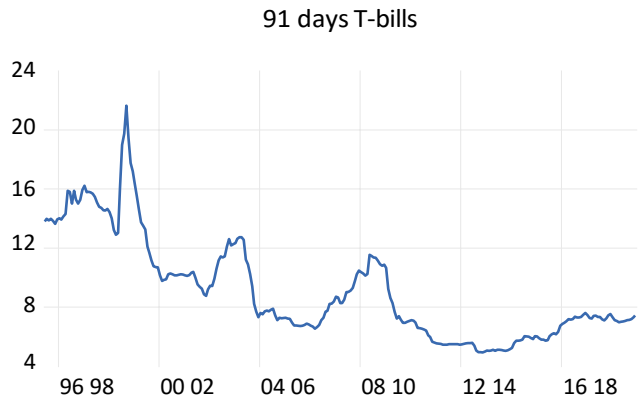
| | | |
|---|---|---|
| Financial and Industrial Indicies | Unanticipated percentage changes in the (rand) gold price | na |
| | Unanticipated returns on the Dow-Jones industrial index | +ve |
| | Unanticipated changes in inflation expectations | -ve |
| | Unanticipated changes in the term structure ofinterest rates | -ve |

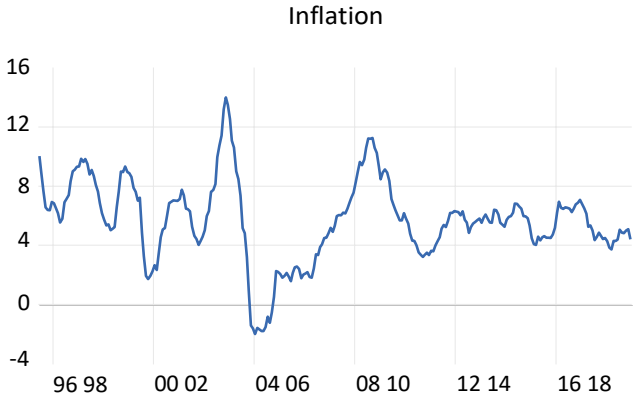
## Appendix 3.1: Indices

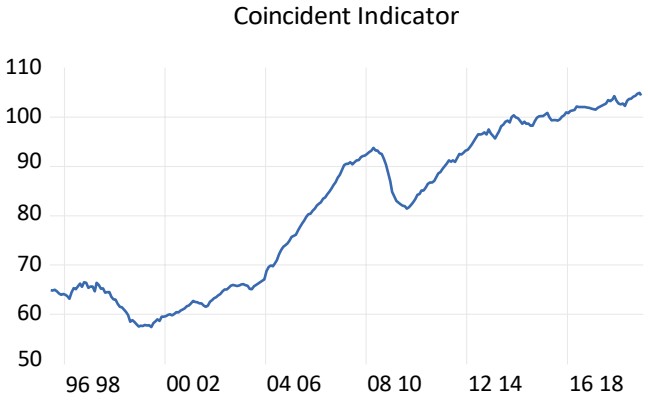


## Appendix 3.2: Macroeconomic Variables



**Appendix 4.1: Export and Import Statistic of South Africa**

| Millions(Rands) | | | | |
|---|---|---|---|---|
| Exports (E) | | Imports(M) | | E-M |
| Date | Value | Date | Value | Value |
| Q3/18 | 952384 | Q3/18 | 1004525 | -52141 |
| Q2/18 | 898932 | Q2/18 | 955173 | -56241 |
| Q1/18 | 890075 | Q1/18 | 953093 | -63018 |
| Q4/17 | 924605 | Q4/17 | 956545 | -31940 |
| Q3/17 | 899793 | Q3/17 | 911840 | -12047 |
| Q2/17 | 911317 | Q2/17 | 950499 | -39182 |
| Q1/17 | 887877 | Q1/17 | 932076 | -44199 |
| Q4/16 | 889581 | Q4/16 | 925185 | -35604 |
| Q3/16 | 901172 | Q3/16 | 915784 | -14612 |
| Q2/16 | 946196 | Q2/16 | 924540 | 21656 |
| Q1/16 | 913236 | Q1/16 | 949410 | -36174 |
| Q4/15 | 904038 | Q4/15 | 968119 | -64081 |
| Q3/15 | 912843 | Q3/15 | 959572 | -46729 |
| Q2/15 | 918234 | Q2/15 | 953828 | -35594 |
| Q1/15 | 902266 | Q1/15 | 982580 | -80314 |
| Q4/14 | 905250 | Q4/14 | 932464 | -27214 |
| Q3/14 | 887760 | Q3/14 | 915464 | -27704 |
| Q2/14 | 839716 | Q2/14 | 897758 | -58042 |
| Q1/14 | 901279 | Q1/14 | 918936 | -17657 |
| Q4/13 | 871700 | Q4/13 | 893882 | -22182 |
| Q3/13 | 853532 | Q3/13 | 941335 | -87803 |
| Q2/13 | 849753 | Q2/13 | 941112 | -91359 |
| Q1/13 | 836989 | Q1/13 | 909093 | -72104 |
| Q4/12 | 824859 | Q4/12 | 890092 | -65233 |
| Q3/12 | 814424 | Q3/12 | 887693 | -73269 |
| Q2/12 | 823169 | Q2/12 | 876216 | -53047 |
| Q1/12 | 818756 | Q1/12 | 855448 | -36692 |
| Q4/11 | 834350 | Q4/11 | 898032 | -63682 |
| Q3/11 | 817082 | Q3/11 | 853526 | -36444 |
| Q2/11 | 803139 | Q2/11 | 811621 | -8482 |
| Q1/11 | 800794 | Q1/11 | 804176 | -3382 |
| Q4/10 | 795722 | Q4/10 | 772032 | 23690 |
| Q3/10 | 796612 | Q3/10 | 778056 | 18556 |
| Q2/10 | 788401 | Q2/10 | 744376 | 44025 |
| Q1/10 | 764661 | Q1/10 | 714468 | 50193 |
| Q4/09 | 736051 | Q4/09 | 697140 | 38911 |
| Q3/09 | 729133 | Q3/09 | 654437 | 74696 |
| Q2/09 | 716284 | Q2/09 | 655786 | 60498 |
| Q1/09 | 738560 | Q1/09 | 708433 | 30127 |
| Q4/08 | 866230 | Q4/08 | 787547 | 78683 |
| Q3/08 | 910966 | Q3/08 | 853162 | 57804 |
| Q2/08 | 891762 | Q2/08 | 834270 | 57492 |
| Q1/08 | 850158 | Q1/08 | 823289 | 26869 |
| Q4/07 | 897510 | Q4/07 | 796427 | 101083 |

| | | | | |
|---|---|---|---|---|
| Q3/07 | 845776 | Q3/07 | 803766 | 42010 |
| Q2/07 | 842816 | Q2/07 | 815241 | 27575 |
| Q1/07 | 879306 | Q1/07 | 792714 | 86592 |
| Q4/06 | 845795 | Q4/06 | 810591 | 35204 |
| Q3/06 | 815550 | Q3/06 | 718681 | 96869 |
| Q2/06 | 793656 | Q2/06 | 726019 | 67637 |
| Q1/06 | 758819 | Q1/06 | 678105 | 80714 |
| Q4/05 | 752099 | Q4/05 | 636757 | 115342 |
| Q3/05 | 770449 | Q3/05 | 639024 | 131425 |
| Q2/05 | 758375 | Q2/05 | 614439 | 143936 |
| Q1/05 | 709716 | Q1/05 | 590221 | 119495 |
| Q4/04 | 735273 | Q4/04 | 592266 | 143007 |
| Q3/04 | 695603 | Q3/04 | 567686 | 127917 |
| Q2/04 | 677143 | Q2/04 | 558663 | 118480 |
| Q1/04 | 646612 | Q1/04 | 518451 | 128161 |
| Q4/03 | 671032 | Q4/03 | 510644 | 160388 |
| Q3/03 | 685616 | Q3/03 | 493493 | 192123 |
| Q2/03 | 660880 | Q2/03 | 474049 | 186831 |
| Q1/03 | 661205 | Q1/03 | 458531 | 202674 |
| Q4/02 | 689075 | Q4/02 | 459114 | 229961 |
| Q3/02 | 651900 | Q3/02 | 445729 | 206171 |
| Q2/02 | 676983 | Q2/02 | 447359 | 229624 |
| Q1/02 | 657846 | Q1/02 | 439649 | 218197 |
| Q4/01 | 649884 | Q4/01 | 424940 | 224944 |
| Q3/01 | 636659 | Q3/01 | 414856 | 221803 |
| Q2/01 | 694394 | Q2/01 | 434548 | 259846 |
| Q1/01 | 668659 | Q1/01 | 426650 | 242009 |
| Q4/00 | 676583 | Q4/00 | 433082 | 243501 |
| Q3/00 | 630256 | Q3/00 | 421986 | 208270 |
| Q2/00 | 629025 | Q2/00 | 414208 | 214817 |
| Q1/00 | 651812 | Q1/00 | 427479 | 224333 |
| Q4/99 | 612948 | Q4/99 | 413948 | 199000 |
| Q3/99 | 602686 | Q3/99 | 400454 | 202232 |
| Q2/99 | 557061 | Q2/99 | 397378 | 159683 |
| Q1/99 | 616361 | Q1/99 | 399001 | 217360 |
| Q4/98 | 571968 | Q4/98 | 440063 | 131905 |
| Q3/98 | 587289 | Q3/98 | 444149 | 143140 |
| Q2/98 | 590808 | Q2/98 | 436695 | 154113 |
| Q1/98 | 609241 | Q1/98 | 436849 | 172392 |
| Q4/97 | 603404 | Q4/97 | 449641 | 153763 |
| Q3/97 | 601771 | Q3/97 | 445784 | 155987 |
| Q2/97 | 547346 | Q2/97 | 416252 | 131094 |
| Q1/97 | 532602 | Q1/97 | 411383 | 121219 |
| Q4/96 | 556852 | Q4/96 | 409716 | 147136 |
| Q3/96 | 585175 | Q3/96 | 427545 | 157630 |
| Q2/96 | 513775 | Q2/96 | 405499 | 108276 |
| Q1/96 | 514404 | Q1/96 | 392253 | 122151 |
| Q4/95 | 524548 | Q4/95 | 385189 | 139359 |
| Q3/95 | 532419 | Q3/95 | 381590 | 150829 |
| Q2/95 | 449612 | Q2/95 | 367894 | 81718 |
| Q1/95 | 517792 | Q1/95 | 369331 | 148461 |

Source: (SARB,2019)

**Appendix 5.1: Descriptive summary (June1995 to December 2018) period**

| Symbol | Mean | Median | Maximum | Minimum | Std Dev | Skewness | Kurtosis | Jarque-Beta | Probability | Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| **J200** | 22517.15 | 19819.52 | 53269.83 | 3989.920 | 15618.63 | 0.479531 | 1.809711 | 27.55224 | 0.000001 | 283 |
| **J203** | 25080.93 | 21953.80 | 59772.83 | 4479.850 | 17767.23 | 0.493649 | 1.818492 | 27.95470 | 0.000001 | 283 |
| **J510** | 18064.33 | 20843.67 | 40596.07 | 2784.160 | 9999.387 | -0.066532 | 1.653678 | 21.58214 | 0.000021 | 283 |
| **J520** | 22819.48 | 21496.09 | 56940.77 | 3371.130 | 16075.37 | 0.371559 | 1.687856 | 26.81359 | 0.000002 | 283 |
| **J530** | 25262.05 | 14109.94 | 83717.14 | 2035.010 | 25505.84 | 0.975966 | 2.422356 | 48.86130 | 0.000000 | 283 |
| **J540** | 3135.629 | 1625.260 | 11187.23 | 367.1800 | 3169.170 | 1.027127 | 2.613346 | 51.52323 | 0.000000 | 283 |
| **J550** | 5990.159 | 2708.550 | 26196.89 | 632.0600 | 6962.730 | 1.394650 | 3.652320 | 96.75909 | 0.000000 | 283 |
| **J560** | 4286.353 | 4686.550 | 11741.43 | 437.3600 | 3237.087 | 0.351487 | 1.912955 | 19.76095 | 0.000051 | 283 |
| **J580** | 20550.08 | 18419.99 | 47449.52 | 4929.610 | 12769.01 | 0.692509 | 2.109782 | 31.96445 | 0.000000 | 283 |
| **J590** | 26103.95 | 21981.28 | 67271.00 | 3355.390 | 17028.54 | 0.517279 | 2.036151 | 23.57524 | 0.000008 | 283 |
| **CI** | 81.39984 | 83.53000 | 104.9600 | 57.41272 | 15.97109 | -0.068489 | 1.429756 | 29.29555 | 0.000000 | 283 |
| **ST** | 9.109461 | 7.610000 | 21.64000 | 4.930000 | 3.461612 | 0.977549 | 3.250959 | 45.81523 | 0.000000 | 283 |
| **INF** | 5.704563 | 5.791506 | 14.00702 | -1.999269 | 2.743622 | -0.174798 | 3.933755 | 11.72229 | 0.002848 | 283 |
| **REEX** | 89.59265 | 89.56000 | 110.3100 | 63.11000 | 9.492666 | -0.086242 | 2.511788 | 3.161370 | 0.205834 | 283 |

Author's computation from Eviews 10

**Appendix 5.2: Descriptive summary (June 1995 to June 2007) sub period**

| Symbol | Mean | Median | Maximum | Minimum | Std Dev | Skewness | Kurtosis | Jarque-Beta | Probability | Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| **J200** | 9532.927 | 7940.130 | 25701.40 | 3989.920 | 5154.691 | 1.595285 | 4.764251 | 80.30776 | 0.000000 | 145 |
| **J203** | 10330.99 | 8402.090 | 28627.79 | 4479.850 | 5756.841 | 1.639059 | 4.871179 | 86.07783 | 0.000000 | 145 |
| **J510** | 10026.24 | 6907.610 | 30854.36 | 2784.160 | 6641.002 | 1.298386 | 4.097857 | 48.02229 | 0.000000 | 145 |
| **J520** | 9387.976 | 6887.400 | 29435.47 | 3371.130 | 6215.680 | 1.758811 | 5.186703 | 103.6468 | 0.000000 | 145 |
| **J530** | 6274.918 | 6031.940 | 16106.55 | 2035.010 | 3552.094 | 1.001893 | 3.475934 | 25.62678 | 0.000003 | 145 |
| **J540** | 810.3237 | 616.3700 | 2250.730 | 367.1800 | 460.7923 | 1.683551 | 4.751713 | 87.03550 | 0.000000 | 145 |
| **J550** | 1343.279 | 1104.900 | 3696.020 | 632.0600 | 711.0503 | 1.647303 | 4.961828 | 88.83180 | 0.000000 | 145 |
| **J560** | 1482.783 | 913.5300 | 5401.310 | 437.3600 | 1177.226 | 1.563676 | 4.704264 | 76.63764 | 0.000000 | 145 |
| **J580** | 10822.75 | 9149.480 | 25731.75 | 4929.610 | 4601.457 | 1.593270 | 4.752226 | 79.89701 | 0.000000 | 145 |
| **J590** | 19422.76 | 12536.79 | 58410.08 | 3355.390 | 14732.14 | 0.878943 | 2.445025 | 20.53054 | 0.000035 | 145 |
| **CI** | 67.87522 | 65.10374 | 90.87008 | 57.41272 | 8.953950 | 1.171009 | 3.284383 | 33.62746 | 0.000000 | 145 |
| **ST** | 11.20917 | 10.34000 | 21.64000 | 6.530000 | 3.406824 | 0.501673 | 2.504202 | 7.567309 | 0.022739 | 145 |
| **INF** | 5.485568 | 5.964663 | 14.00702 | -1.999269 | 3.431600 | -0.175161 | 2.773553 | 1.051270 | 0.591180 | 145 |
| **REEX** | 92.39097 | 92.69000 | 110.3100 | 63.11000 | 10.00008 | -0.573414 | 3.096713 | 8.002589 | 0.018292 | 145 |

Author's computation from Eviews 10

**Appendix 5.3: Descriptive summary (July 2007 to December 2018) sub period**

| Symbol | Mean | Median | Maximum | Minimum | Std Dev | Skewness | Kurtosis | Jarque-Beta | Probability | Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| **J200** | 36159.99 | 35256.93 | 53269.83 | 16514.30 | 10405.73 | -0.053090 | 1.577804 | 11.69502 | 0.002887 | 138 |
| **J203** | 40579.05 | 39785.20 | 59772.83 | 18465.33 | 11947.30 | -0.051162 | 1.554010 | 12.08280 | 0.002378 | 138 |
| **J510** | 26510.15 | 26488.54 | 40596.07 | 16790.87 | 4384.241 | 0.460099 | 3.684841 | 7.565694 | 0.022758 | 138 |
| **J520** | 36932.28 | 40314.04 | 56940.77 | 17767.40 | 9987.555 | -0.125574 | 1.654948 | 10.76537 | 0.004595 | 138 |
| **J530** | 45212.30 | 46584.06 | 83717.14 | 13320.35 | 23309.67 | 0.056269 | 1.452595 | 13.84098 | 0.000987 | 138 |
| **J540** | 5578.886 | 5440.290 | 11187.23 | 1408.630 | 2952.072 | 0.128746 | 1.639763 | 11.02015 | 0.004046 | 138 |
| **J550** | 10872.75 | 8287.920 | 26196.89 | 2488.870 | 7238.134 | 0.517798 | 1.896331 | 13.17062 | 0.001380 | 138 |
| **J560** | 7232.133 | 6880.430 | 11741.43 | 4227.190 | 1747.212 | 0.879359 | 2.964703 | 17.79243 | 0.000137 | 138 |
| **J580** | 30770.82 | 30240.05 | 47449.52 | 13068.88 | 10391.76 | 0.032947 | 1.455507 | 13.74135 | 0.001038 | 138 |
| **J590** | 33124.05 | 29711.86 | 67271.00 | 8421.430 | 16488.27 | 0.250466 | 1.801179 | 9.706607 | 0.007803 | 138 |
| **CI** | 95.61051 | 97.32000 | 104.9600 | 81.41000 | 6.615367 | -0.598900 | 2.220841 | 11.74043 | 0.002822 | 138 |
| **ST** | 6.903242 | 6.800000 | 11.55000 | 4.930000 | 1.701939 | 1.197768 | 3.720034 | 35.97799 | 0.000000 | 138 |
| **INF** | 5.934666 | 5.721402 | 11.26850 | 3.202329 | 1.735747 | 1.160627 | 4.342069 | 41.33885 | 0.000000 | 138 |
| **REER** | 86.65239 | 85.77000 | 104.3700 | 68.44000 | 7.960908 | 0.254823 | 2.350269 | 3.920861 | 0.140798 | 138 |

Author's computation from Eviews 10

## Appendix 5.4: ADF (intercept) and PP (intercept) tests from June 1995 to December 2018 period

| Variables | ADF(Intercept) | | | PP (Intercept) | | |
|---|---|---|---|---|---|---|
| | Level (p value) | 1st Difference (p value) | Order of Integration | Level (p value) | 1st Difference (p value) | Order of Integration |
| **J200** | 0.9559 | 0.0000* | I(1) | 0.9594 | 0.0000* | I(1) |
| **J203** | 0.9439 | 0.0000* | I(1) | 0.9490 | 0.0000* | I(1) |
| **J510** | 0.6423 | 0.0000* | I(1) | 0.6068 | 0.0000* | I(1) |
| **J520** | 0.6760 | 0.0000* | I(1) | 0.6650 | 0.0000* | I(1) |
| **J530** | 0.9062 | 0.0000* | I(1) | 0.9043 | 0.0000* | I(1) |
| **J540** | 0.9986 | 0.0000* | I(1) | 0.9995 | 0.0000* | I(1) |
| **J550** | 0.8756 | 0.0000* | I(1) | 0.8762 | 0.0000* | I(1) |
| **J560** | 0.4251 | 0.0000* | I(1) | 0.4240 | 0.0000* | I(1) |
| **J580** | 0.8196 | 0.0000* | I(1) | 0.7833 | 0.0000* | I(1) |
| **J590** | 0.9305 | 0.0000* | I(1) | 0.9366 | 0.0000* | I(1) |
| **CI** | 0.0511*** | 0.0000* | I(0) | 0.0630*** | 0.0000* | I(0) |
| **ST** | 0.1174 | 0.0000* | I(1) | 0.0070* | 0.0000* | I(0) |
| **INF** | 0.2605 | 0.0000* | I(1) | 0.3817 | 0.0000* | I(1) |
| **REER** | 0.8779 | 0.0002* | I(1) | 0.9403 | 0.0000* | I(1) |

## Appendix 5.5: ADF (intercept and trend) and PP (intercept and trend) tests from June 1995 to December 2018 period

| Variables | ADF(Intercept and Trend) | | | PP (Intercept and Trend) | | |
|---|---|---|---|---|---|---|
| | Level(p value) | 1st Difference(p value) | Order of Integration | Level(p value) | 1st Difference(p value) | Order of Integration |
| **J200** | 0.4013 | 0.0000* | I(1) | 0.4173 | 0.0000* | I(1) |
| **J203** | 0.3352 | 0.0000* | I(1) | 0.3527 | 0.0000* | I(1) |
| **J510** | 0.5481 | 0.0000* | I(1) | 0.5189 | 0.0000* | I(1) |
| **J520** | 0.9736 | 0.0000* | I(1) | 0.9440 | 0.0000* | I(1) |
| **J530** | 0.3864 | 0.0000* | I(1) | 0.3368 | 0.0000* | I(1) |
| **J540** | 0.9999 | 0.0000* | I(1) | 0.9524 | 0.0000* | I(1) |
| **J550** | 0.8329 | 0.0000* | I(1) | 0.8315 | 0.0000* | I(1) |
| **J560** | 0.7883 | 0.0000* | I(1) | 0.7869 | 0.0000* | I(1) |
| **J580** | 0.9514 | 0.0000* | I(1) | 0.8869 | 0.0000* | I(1) |
| **J590** | 0.6288 | 0.0000* | I(1) | 0.6374 | 0.0000* | I(1) |
| **CI** | 0.1552 | 0.0000* | I(1) | 0.1314 | 0.0000* | I(1) |
| **ST** | 0.3242 | 0.0000* | I(1) | 0.0346** | 0.0000* | I(0) |
| **INF** | 0.2054 | 0.0000* | I(1) | 0.3912 | 0.0000* | I(1) |
| **REER** | 0.3576 | 0.0016* | I(1) | 0.4358 | 0.0000* | I(1) |

Author's computation from Eviews 10

Notes: *, **, and *** denote the rejection of the null hypothesis of unit root at the 1%, 5% and 10% level of significance respectively. The lag order for the series was determined by the Schwarz information criterion

## Appendix 5.6: ADF (intercept) and PP (intercept) tests from June 1995 to June 2007 sub period

| Variables | ADF(Intercept) | | | PP (Intercept) | | |
|---|---|---|---|---|---|---|
| | Level (p value) | 1st Difference (p value) | Order of Integration | Level (p value) | 1st Difference (p value) | Order of Integration |
| **J200** | 1.0000 | 0.0000* | I(1) | 1.0000 | 0.0000* | I(1) |
| **J203** | 1.0000 | 0.0000* | I(1) | 1.0000 | 0.0000* | I(1) |
| **J510** | 1.0000 | 0.0000* | I(1) | 1.0000 | 0.0000* | I(1) |
| **J520** | 0.9996 | 0.0000* | I(1) | 0.9999 | 0.0000* | I(1) |
| **J530** | 1.0000 | 0.0000* | I(1) | 1.0000 | 0.0000* | I(1) |
| **J540** | 0.9832 | 0.0000* | I(1) | 0.9996 | 0.0000* | I(1) |
| **J550** | 0.9992 | 0.0001* | I(1) | 0.9987 | 0.0000* | I(1) |
| **J560** | 0.4886 | 0.0000* | I(1) | 0.4863 | 0.0000* | I(1) |
| **J580** | 0.9999 | 0.0000* | I(1) | 1.0000 | 0.0000* | I(1) |
| **J590** | 0.9937 | 0.0000* | I(1) | 0.9950 | 0.0000* | I(1) |
| **INCI** | 0.9731 | 0.0919*** | I(1) | 0.9999 | 0.0000* | I(1) |
| **ST** | 0.3874 | 0.0000* | I(1) | 0.5372 | 0.0000* | I(1) |
| **INF** | 0.4587 | 0.0001* | I(1) | 0.0864*** | 0.0000* | I(0) |
| **REER** | 0.3284 | 0.0000* | I(1) | 0.2607 | 0.0000* | I(1) |

Author's computation from Eviews 10

Notes: *, **, and *** denote the rejection of the null hypothesis of unit root at the 1%, 5% and 10% level of significance respectively. The lag order for the series was determined by the Schwarz information criterion.

## Appendix 5.7: ADF (intercept and trend) and PP (intercept and trend) tests from June 1995 to June 2007 sub period

| Variables | ADF(Intercept and trend) | | | PP (Intercept and Trend) | | |
|---|---|---|---|---|---|---|
| | Level (p value) | 1st Difference (p value) | Order of Integration | Level (p value) | 1st Difference (p value) | Order of Integration |
| **J200** | 1.0000 | 0.0000* | I(1) | 1.0000 | 0.0000* | I(1) |
| **J203** | 0.9999 | 0.0000* | I(1) | 0.9999 | 0.0000* | I(1) |
| **J510** | 0.9996 | 0.0000* | I(1) | 0.9998 | 0.0000* | I(1) |
| **J520** | 0.9953 | 0.0000* | I(1) | 0.9970 | 0.0000* | I(1) |
| **J530** | 1.0000 | 0.0000* | I(1) | 1.0000 | 0.0000* | I(1) |
| **J540** | 0.9733 | 0.0000* | I(1) | 0.9991 | 0.0000* | I(1) |
| **J550** | 0.9901 | 0.0000* | I(1) | 0.9830 | 0.0000* | I(1) |
| **J560** | 0.5462 | 0.0000* | I(1) | 0.5559 | 0.0000* | I(1) |
| **J580** | 0.9972 | 0.0000* | I(1) | 0.9992 | 0.0000* | I(1) |
| **J590** | 0.9859 | 0.0000* | I(1) | 0.9833 | 0.0000* | I(1) |
| **[9]INCI** | 0.9155 | 0.0888*** | I(1) | 0.9787 | 0.0000* | I(1) |
| **ST** | 0.1260 | 0.0000* | I(1) | 0.2824 | 0.0000* | I(1) |
| **INF** | 0.7085 | 0.0008* | I(1) | 0.2194 | 0.0000* | I(1) |
| **REER** | 0.6761 | 0.0000* | I(1) | 0.5878 | 0.0000* | I(1) |

Author's computation from Eviews 10

[9] It was only stationary only when the variable is logged (CI).

Notes: *, **, and *** denote the rejection of the null hypothesis of unit root at the 1%, 5% and 10% level of significance respectively. The lag order for the series was determined by the Schwarz information criterion.

## Appendix 5.8: ADF (intercept) and PP (intercept) tests from July 2007 to December 2018 sub period

| Variables | ADF(Intercept) | | | PP (Intercept) | | |
|---|---|---|---|---|---|---|
| | Level (p value) | 1st Difference (p value) | Order of Integration | Level (p value) | 1st Difference (p value) | Order of Integration |
| **J200** | 0.8101 | 0.0000* | I(1) | 0.8253 | 0.0000* | I(1) |
| **J203** | 0.8317 | 0.0000* | I(1) | 0.8438 | 0.0000* | I(1) |
| **J510** | 0.0752*** | 0.0000* | I(0) | 0.0434** | 0.0000* | I(0) |
| **J520** | 0.4814 | 0.0000* | I(1) | 0.5506 | 0.0000* | I(1) |
| **J530** | 0.7838 | 0.0000* | I(1) | 0.7928 | 0.0000* | I(1) |
| **J540** | 0.9512 | 0.0000* | I(1) | 0.9644 | 0.0000* | I(1) |
| **J550** | 0.6653 | 0.0000* | I(1) | 0.6659 | 0.0000* | I(1) |
| **J560** | 0.7075 | 0.0000* | I(1) | 0.6380 | 0.0000* | I(1) |
| **J580** | 0.6573 | 0.0000* | I(1) | 0.6400 | 0.0000* | I(1) |
| **J590** | 0.8831 | 0.0000* | I(1) | 0.8950 | 0.0000* | I(1) |
| **CI** | 0.7663 | 0.0005* | I(1) | 0.8589 | 0.0000* | I(1) |
| **ST** | 0.2719 | 0.0016* | I(1) | 0.5262 | 0.0000* | I(1) |
| **INF** | 0.3215 | 0.0000* | I(1) | 0.3237 | 0.0000* | I(1) |
| **REER** | 0.2537 | 0.0000* | I(1) | 0.2537 | 0.0000* | I(1) |

Author's computation from Eviews 10

Notes: *, **, and *** denote the rejection of the null hypothesis of unit root at the 1%, 5% and 10% level of significance respectively. The lag order for the series was determined by the Schwarz information criterion.

## Appendix 5.9: ADF (intercept and trend) and PP (intercept and trend) tests from July 2007 to December 2018 sub period

| Variables | ADF (Intercept and Trend) | | | PP (Intercept and Trend) | | |
|---|---|---|---|---|---|---|
| | Level (p value) | 1st Difference (p value) | Order of Integration | Level (p value) | 1st Difference (p value) | Order of Integration |
| **J200** | 0.4090 | 0.0000* | I(1) | 0.4166 | 0.0000* | I(1) |
| **J203** | 0.3689 | 0.0000* | I(1) | 0.3722 | 0.0000* | I(1) |
| **J510** | 0.2300 | 0.0000* | I(1) | 0.1274 | 0.0000* | I(1) |
| **J520** | 0.9660 | 0.0000* | I(1) | 0.9016 | 0.0000* | I(1) |
| **J530** | 0.4357 | 0.0000* | I(1) | 0.4135 | 0.0000* | I(1) |
| **J540** | 0.1849 | 0.0000* | I(1) | 0.2137 | 0.0000* | I(1) |
| **J550** | 0.9959 | 0.0000* | I(1) | 0.9972 | 0.0000* | I(1) |
| **J560** | 0.9948 | 0.0000* | I(1) | 0.9759 | 0.0000* | I(1) |
| **J580** | 0.9996 | 0.0000* | I(1) | 0.9990 | 0.0000* | I(1) |
| **J590** | 0.3417 | 0.0000* | I(1) | 0.3487 | 0.0000* | I(1) |
| **CI** | 0.2848 | 0.0032* | I(1) | 0.4966 | 0.0000* | I(1) |
| **ST** | 0.8248 | 0.0019* | I(1) | 0.9218 | 0.0000* | I(1) |
| **INF** | 0.3548 | 0.0000* | I(1) | 0.4001 | 0.0000* | I(1) |
| **REER** | 0.5299 | 0.0000* | I(1) | 0.4173 | 0.0000* | I(1) |

Author's computation from Eviews 10

Notes: *, **, and *** denote the rejection of the null hypothesis of unit root at the 1%, 5% and 10% level of significance respectively. The lag order for the series was determined by the Schwarz information criterion.

## Appendix 5.10: Lag Selection-Order Criteria (June 1995 to December 2018) period

| | June 1995 to December 2018 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lag criteria** | **lnJ200** | **InJ203** | **InJ510** | **InJ520** | **InJ530** | **InJ540** | **InJ550** | **InJ560** | **InJ580** | **InJ590** |
| **LR** | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| **FPE** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **AIC** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **SC** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **HQ** | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

**Notes**
**LR: sequential modified LR test statistic (each test at 5% level)**
**FPE: Final prediction error**
**AIC: Akaike information criterion**
**SC: Schwarz information criterion**
**HQ: Hannan-Quinn information criterion**
**Source: INET BFA (2019) and the author's own estimates using Eviews 10.**

## Appendix 5.11: Lag Selection-Order Criteria (June 1995 to June 2007) sub period

| | June 1995 to June 2007 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lag criteria** | **InJ200** | **InJ203** | **InJ510** | **InJ520** | **InJ530** | **InJ540** | **InJ550** | **InJ560** | **InJ580** | **InJ590** |
| **LR** | 3 | 3 | 8 | 3 | 2 | 7 | 3 | 6 | 8 | 8 |
| **FPE** | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 |
| **AIC** | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 |
| **SC** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **HQ** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |

**Notes**
**LR: sequential modified LR test statistic (each test at 5% level)**
**FPE: Final prediction error**
**AIC: Akaike information criterion**
**SC: Schwarz information criterion**
**HQ: Hannan-Quinn information criterion**
**Source: INET BFA (2019) and the author's own estimates using Eviews 10.**

## Appendix 5.12 Lag Selection-Order Criteria (July 2007 to December 2018) sub period

| July 2007 to December 2018 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lag criteria** | **InJ200** | **InJ203** | **InJ510** | **InJ520** | **InJ530** | **InJ540** | **InJ550** | **InJ560** | **InJ580** | **J590** |
| **LR** | 8 | 8 | 8 | 8 | 8 | 8 | 6 | 8 | 8 | 8 |
| **FPE** | 8 | 8 | 8 | 6 | 5 | 5 | 6 | 5 | 6 | 6 |
| **AIC** | 8 | 8 | 8 | 8 | 6 | 5 | 6 | 5 | 8 | 6 |
| **SC** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **HQ** | 8 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |

**Notes**
**LR: sequential modified LR test statistic (each test at 5% level)**
**FPE: Final prediction error**
**AIC: Akaike information criterion**
**SC: Schwarz information criterion**
**HQ: Hannan-Quinn information criterion**
**Source: INET BFA (2019) and the author's own estimates using Eviews 10.**

## Appendix 5.13 Bound test results (June 1995 to December 2018) period

| **Equation** | **F-statistic** | **Determination** | **Specification** |
|---|---|---|---|
| **K=7** | | | |
| **In(J200)=F((In(CI), In(REER), ST, INF))** | 4.690005 | Cointegrated | ARDL(1, 0, 0, 0, 0, 0, 0, 0) |
| **In(J203)=F((In(CI), In(REER), ST, INF))** | 4.701383 | Cointegrated | ARDL(1, 0, 0, 0, 0, 0, 0, 0) |
| **In(J510)=F((In(CI), In(REER), ST, INF))** | 2.797706 | Not Cointegrated | ARDL(1, 0, 0, 0, 0, 0, 0, 1) |
| **In(J520)=F((In(CI), In(REER), ST, INF))** | 6.337378 | Cointegrated | ARDL(1, 1, 0, 0, 0, 0, 0, 1) |
| **In(J530)=F((In(CI), In(REER), ST, INF))** | 3.016509 | Cointegrated | ARDL(1, 0, 0, 0, 0, 0, 0, 0) |
| **In(J540)=F((In(CI), In(REER), ST, INF))** | 3.323573 | Cointegrated | ARDL(1, 1, 0, 0, 0, 0, 0, 1) |
| **In(J550)=F((In(CI), In(REER), ST, INF))** | 4.270229 | Cointegrated | ARDL(1, 1, 0, 0, 1, 0, 0, 0) |
| **In(J560)=F((In(CI), In(REER), ST, INF))** | 5.766041 | Cointegrated | ARDL(1, 1, 0, 0, 0, 0, 0, 0) |
| **In(J580)=F((In(CI), In(REER), ST, INF))** | 4.106803 | Cointegrated | ARDL(1, 1, 0, 0, 0, 0, 0, 0) |
| **In(J590)=F((In(CI), In(REER), ST, INF))** | 4.667980 | Cointegrated | ARDL(1, 0, 0, 0, 0, 0, 0, 0) |
| **Critical Value Bounds** | | | |
| **Significance** | **I(0) Bound** | **I(1) Bound** | |
| **10%** | **1.92** | **2.89** | |
| **5%** | **2.17** | **3.21** | |
| **2.5%** | **2.43** | **3.51** | |
| **1%** | **2.73** | **3.9** | |

## Appendix 5.14 Bound test results (June 1995 to June 2007) sub period

| Equation | F-statistic | Determination | Specification |
|---|---|---|---|
| **K=6** | | | |
| **In(J200)=F((In(CI), In(REER), ST, INF))** | 3.907809 | Cointegrated | ARDL(1, 0, 0, 0, 0, 0, 0) |
| **In(J203)=F((In(CI), In(REER), ST, INF))** | 3.445942 | Cointegrated | ARDL(1, 0, 0, 1, 0, 0, 0) |
| **In(J510)=F((In(CI), In(REER), ST, INF))** | 4.666376 | Cointegrated | ARDL(1, 0, 0, 0, 0, 0, 1) |
| **In(J520)=F((In(CI), In(REER), ST, INF))** | 4.744665 | Cointegrated | ARDL(1, 0, 0, 1, 0, 0, 0) |
| **In(J530)=F((In(CI), In(REER), ST, INF))** | 2.245122 | Not cointegrated | ARDL(1, 0, 0, 0, 0, 0, 0) |
| **In(J540)=F((In(CI), In(REER), ST, INF))** | 4.576375 | Cointegrated | ARDL(1, 0, 0, 0, 1, 0, 0) |
| **In(J550)=F((In(CI), In(REER), ST, INF))** | 3.375628 | Cointegrated | ARDL(1, 0, 0, 0, 1, 0, 0) |
| **In(J560)=F((In(CI), In(REER), ST, INF))** | 2.762220 | Not cointegrated | ARDL(1, 0, 0, 0, 1, 0, 0) |
| **In(J580)=F((In(CI), In(REER), ST, INF))** | 2.621402 | Not cointegrated | ARDL(1, 0, 0, 0, 1, 0, 0) |
| **In(J590)=F((In(CI), In(REER), ST, INF))** | 3.028667 | Cointegrated | ARDL(1, 0, 0, 0, 0, 0, 0) |
| **Critical Value Bounds** | | | |
| **Significance** | **I(0) Bound** | **I(1) Bound** | |
| **10%** | **1.99** | **2.94** | |
| **5%** | **2.27** | **3.28** | |
| **2.5%** | **2.55** | **3.61** | |
| **1%** | **2.88** | **3.99** | |

## Appendix 5.15 Bound test results (July 2007 to December 2018) sub period

| Equation | F-statistic | Determination | Specification |
|---|---|---|---|
| **K=5** | | | |
| **In(J200)=F((In(CI), In(REER), ST, INF))** | 3.531280 | Cointegrated | ARDL(1, 0, 0, 0, 1, 0) |
| **In(J203)=F((In(CI), In(REER), ST, INF))** | 3.622338 | Cointegrated | ARDL(1, 0, 1, 0, 0, 0) |
| **In(J510)=F((In(CI), In(REER), ST, INF))** | 2.418726 | Not Cointegrated | ARDL(1, 0, 0, 0, 1, 0) |
| **In(J520)=F((In(CI), In(REER), ST, INF))** | 2.802326 | Not Cointegrated | ARDL(1, 1, 0, 0, 0, 0) |
| **In(J530)=F((In(CI), In(REER), ST, INF))** | 2.609510 | Not Cointegrated | ARDL(1, 0, 0, 0, 0, 0) |
| **In(J540)=F((In(CI), In(REER), ST, INF))** | 3.324262 | Cointegrated | ARDL(1, 1, 0, 1, 0, 0) |
| **In(J550)=F((In(CI), In(REER), ST, INF))** | 2.584573 | Not Cointegrated | ARDL(1, 0, 0, 1, 0, 0) |
| **In(J560)=F((In(CI), In(REER), ST, INF))** | 3.536767 | Cointegrated | ARDL(1, 1, 0, 0, 1, 0) |
| **In(J580)=F((In(CI), In(REER), ST, INF))** | 3.096055 | Cointegrated | ARDL(1, 1, 0, 0, 0, 0) |
| **In(J590)=F((In(CI), In(REER), ST, INF))** | 3.769870 | Cointegrated | ARDL(1, 1, 0, 1, 0, 0) |
| **Critical Value Bounds** | | | |
| **Significance** | **I(0) Bound** | **I(1) Bound** | |
| **10%** | **2.08** | **3** | |
| **5%** | **2.39** | **3.38** | |
| **2.5%** | **2.7** | **3.73** | |
| **1%** | **3.06** | **4.15** | |

**Appendix 5.16: Long-run ARDL results for JSE All Share Index and sector indices (June 1995 to December 2018) period**

| Variables | InJ200 | InJ203 | InJ510 | InJ520 | InJ530 | InJ540 | InJ550 | InJ560 | InJ580 | InJ590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **C** | 0.109017 | 0.414700 | -0.462569*** | -4.762010* | 15.66303 | 4.549442 | -10.82508 | 9.554390 | -1.771067 | 42.76237 |
| **INREER** | -0.660705** | -0.652375** | -0.462569 | 0.010148 | -1.436047 | -0.835718 | -1.145822 | -0.525577 | -0.155709 | 5.288165 |
| **INCI** | 3.020796* | 2.982937* | 0.622516 | 3.420632* | 0.770935 | 2.011513 | 5.645133 | 0.657741 | 2.876398* | -11.51954 |
| **INF** | -0.011930 | -0.010150 | -0.022681 | 0.002258 | -0.075374 | 0.011048 | -0.036940 | 0.022775 | -0.022234 | 0.187809 |
| **ST** | -0.055348* | -0.063374* | -0.144466* | -0.055479 | -0.221302 | -0.202240*** | -0.010345 | -0.230750* | -0.017862 | -0.564944 |
| **ASIAN CRISIS** | -0.076615 | -0.021506 | -1.053858*** | -0.146495 | -0.585868 | -0.186052 | 0.631076 | 0.240520 | 0.468178 | 3.922829 |
| **DOT COM** | 0.028936 | -0.041218 | -0.075007 | 0.011848 | -0.809545 | -0.481050 | -0.738912*** | -1.144972** | -0.008059 | -12.22896 |
| **2007 CRISIS** | -0.089277 | -0.118963 | 0.510552 | -0.087389 | -0.237430 | -0.573179 | -1.278148* | 0.638673* | -0.465916* | -2.514984 |

Author's computation from Eviews 10

Note:*,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively

**Appendix 5.17: Long-run ARDL results for JSE All Share Index and sector indices (June 1995 to June 2007) sub period**

| Variables | InJ200 | InJ203 | InJ510 | InJ520 | InJ530 | InJ540 | InJ550 | InJ560 | InJ580 | InJ590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **C** | 2.401553 | 1.046939 | 5.969739* | -5.765510* | 7.492244 | -8.377501* | -8.894526 | 4.529925 | -5.941931 | -1.363655 |
| **INREER** | -0.871034* | -0.988595* | -1.793421* | 0.049720 | -1.080191 | -0.320088 | 0.709897* | -0.394279 | 0.496847 | 4.816024 |
| **INCI** | 2.670731* | 3.109508* | 2.938132* | 3.578371* | 1.726178 | 3.912997* | 3.129884 | 1.605165 | 3.095323* | -2.298459 |
| **INF** | -0.000341 | -0.011711 | 0.019112 | 0.009955 | -0.079361 | -0.022811 | -0.008556 | 0.015630 | -0.021328 | -0.192132 |
| **ST** | -0.054221* | -0.038096 | -0.104091 | -0.049399* | -0.057095 | 0.004796 | -0.019729 | -0.189906 | 0.002654 | 0.120733 |
| **ASIAN CRISIS** | -0.020108 | 0.002497 | -0.387171** | -0.069482 | -0.411364 | 0.070068 | 0.234719 | 0.092663 | 0.298906 | 2.198904 |
| **DOT COM** | -0.009383 | 0.012751 | -0.290482*** | 0.053891 | 0.129629 | 0.120925 | -0.329087 | -1.010705 | 0.191898 | -5.222002 |

Author's computation from Eviews 10

Note: *,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively

**Appendix 5.18: Long-run ARDL results for JSE All Share Index and sector indices (July 2007 to December 2018) sub period**

| Variables | InJ200 | InJ203 | InJ510 | InJ520 | InJ530 | InJ540 | InJ550 | InJ560 | InJ580 | InJ590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **C** | 5.149791 | 3.643737 | 8.771678 | -0.494729 | 17.29886 | -2.694517 | -10.85987 | -0.855864** | 2.669304 | 28.67329 |
| **INREER** | -0.920434** | -0.978929* | 0.621738 | -0.313288 | -2.180067 | -2.694517** | -1.336372 | -0.855864 | -0.994434** | -2.046869 |
| **INCI** | 2.211205* | 2.603148* | -0.173828 | 2.791246* | 1.122651 | 0.128912 | 5.875011* | 0.229991 | 2.770269* | -1.407495 |
| **INF** | -0.081671** | -0.081001* | -0.041647 | -0.014841 | -0.022088 | 0.100584 | -0.058620 | -0.002829 | -0.049734 | -0.467019 |
| **ST** | -0.022764 | -0.008824 | -0.057973 | -0.030348 | -0.258255 | -0.402687 | -0.023207 | -0.233598* | -0.029116 | 0.079380*** |
| **2007 CRISIS** | -0.015730 | -0.078728 | 0.426603** | -0.213738 | -0.254704 | -0.093506 | -0.961799** | 0.718628** | -0.328891 | -0.039029 |

Author's computation from Eviews 10

Note: *,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively

**Appendix 5.19: Short results for JSE All Share Index and sector indices (June 1995 to December 2018) period**

| Variables | D(InJ200) | D(InJ203) | D(InJ510) | D(InJ520) | D(InJ530) | D(InJ540) | D(InJ550) | D(InJ560) | D(InJ580) | D(InJ590) |
|---|---|---|---|---|---|---|---|---|---|---|
| **C** | 0.006954*** | 0.007340*** | 0.003000 | 0.009987** | 0.013419* | 0.007408*** | 0.013317* | 0.010692*** | 0.009755** | 0.012082*** |
| **D(INREER)** | 0.018378 | 0.064999 | 0.082665 | 0.439211* | -0.154573 | 0.330291* | 0.271613** | 0.466055* | 0.320032* | 0.059146 |
| **D(INCI)** | 1.897573* | 1.759931* | 1.503923** | 1.164698** | 1.776233* | 0.704953 | 1.208443** | 1.315216*** | 0.991968*** | 1.970001** |
| **D(INF)** | -0.000685 | -0.000717 | 0.001125 | 0.006713 | 0.001000 | -0.007102 | 0.002596 | 0.004494 | 0.007150 | -0.004237 |
| **D(ST)** | -0.020922* | -0.020158* | -0.018740*** | -0.018877** | -0.011689 | -0.015195*** | -0.022741** | -0.040958* | -0.022776* | 0.004463 |
| **ASIAN_CRISIS** | -0.002796 | 0.002320 | 0.121979** | 0.073307*** | -0.006188 | 0.069340 | 0.009991 | 0.014299 | 0.023292 | 0.058225*** |
| **DOT_COM** | -0.002927 | -0.003595 | 0.019999 | -0.002551 | -0.013817 | 0.008146 | -0.027853 | -0.039478** | -0.013918 | -0.093290* |
| **2007 CRISIS** | -0.011630 | -0.012354 | -0.010861 | -0.022995*** | -0.012380 | -0.007683 | -0.017374 | -0.004613 | -0.028011** | -0.017333 |
| **ECM(-1)** | -0.121162* | -0.105719* | [10] | -0.162334* | -0.024013* | -0.035691* | -0.042539* | -0.083198* | -0.085048* | -0.009404* |

Author's computation from Eviews 10

Note: *,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively

**Appendix 5.20 Short results for JSE All Share Index and sector indices (June 1995 to June 2007) sub period**

| Variables | D(InJ200) | D(InJ203) | D(InJ510) | D(InJ520) | D(InJ530) | D(InJ540) | D(InJ550) | D(InJ560) | D(InJ580) | D(InJ590) |
|---|---|---|---|---|---|---|---|---|---|---|
| **C** | 0.010240 | 0.010899*** | 0.007122 | 0.013228*** | 0.017007** | 0.006119 | 0.008753 | 0.024838** | 0.011466 | 0.021585*** |
| **D(INREER)** | -0.171562 | -0.120349 | -0.083640 | 0.395910*** | -0.270669 | 0.150028 | 0.395334** | 0.310168 | 0.144538 | -0.473934 |
| **D(INCI)** | 2.157056* | 1.929201* | 1.675212*** | 1.560882** | 1.689507** | 1.360110*** | 1.445998 | 1.706472 | 1.290157 | 2.213792 |
| **D(INF)** | 0.005912 | 0.007906 | 0.002940 | 0.017012** | 0.009243 | 0.003925 | 0.009800 | 0.007172 | 0.014441*** | 0.001861 |
| **D(ST)** | -0.032785* | -0.028627* | -0.026828** | -0.028173** | -0.020595*** | -0.026123** | -0.025858* | -0.056126* | -0.031186* | -0.005503 |
| **ASIAN_CRISIS** | -0.005224 | -0.001430 | 0.108685 | -0.015141 | -0.004831 | -0.007725 | 0.014363 | 0.001812 | 0.021545 | 0.047400 |
| **DOT_COM** | -0.009233 | -0.010422 | 0.014191 | -0.010802 | -0.022333 | 0.003122 | -0.025191** | -0.055782* | -0.020822** | -0.107718* |

[10] ECM(-1) for J510 is blank because no cointegration in Appendix 5.13

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **ECM(-1)** | -0.214597* | -0.174407* | -0.164266* | -0.240495* | [11] | -0.234175* | -0.104282* | | | -0.015880* |

Author's computation from Eviews 10

Note: *,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively

**Appendix 5.21: Short results for JSE All Share Index and sector indices (July 2007 to December 2018) sub period**

| Variables | D(InJ200) | D(InJ203) | D(InJ510) | D(InJ520) | D(InJ530) | D(InJ540) | D(InJ550) | D(InJ560) | D(InJ580) | D(InJ590) |
|---|---|---|---|---|---|---|---|---|---|---|
| **C** | 0.005022 | 0.005780 | 0.000263 | 0.007066** | 0.008595 | 0.007030 | 0.018545* | -0.000586* | 0.009014** | 0.005447 |
| **D(INREER)** | 0.104765 | 0.200053*** | 0.182672 | 0.481672* | -0.115929 | 0.561772* | 0.132747 | 0.502776 | 0.544821* | 0.513703* |
| **D(INCI)** | 1.189703*** | 1.119395*** | 0.835375 | 0.383422 | 1.241756*** | 0.178757 | 1.125761 | -0.071707 | 0.482946 | 1.452591* |
| **D(INF)** | -0.007709 | -0.013351 | 0.007762 | -0.010904 | -0.023268** | -0.030976** | -0.043825* | 0.005141 | -0.021065 | 0.002509 |
| **D(ST)** | 0.038286** | 0.017133 | 0.034241 | 0.007919 | 0.017097 | -0.011827 | 0.005923 | 0.066895* | -4.07E-05** | 0.050314*** |
| **2007 CRISIS** | -0.010317 | -0.010744 | -0.010129 | -0.022800** | -0.004595 | -0.003473 | -0.018436 | -0.001100 | -0.029720* | -0.015416 |
| **ECM(-1)** | -0.141798* | -0.154966* | [12] | | | -0.041245* | | -0.131472* | -0.096249* | -0.045922* |

Author's computation from Eviews 10

Note:*,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively

**Appendix 5.22: Diagnostic Test (June 1995 to December 2018) period**

| Variables | InJ200 | InJ203 | InJ510 | InJ520 | InJ530 | InJ540 | InJ550 | InJ560 | InJ580 | InJ590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Autocorrelation: LM test(p value)** | 0.2506 | 0.3164 | 0.3467 | 0.5341 | 0.0148** | 0.5133 | 0.2614 | 0.2398 | 0.1302 | 0.8762 |
| **Heteroscedasticity: ARCH** | 0.1955 | 0.1507 | 0.0576*** | 0.0669*** | 0.3714 | 0.2236 | 0.1081 | 0.0000* | 0.2452 | 0.3670 |
| **Normality : Jarque-Bera(p value)** | 0.000000* | 0.000000* | 0.0000000* | 0.000000* | 0.000000* | 0.000000* | 0.000000* | 0.000000* | 0.000000* | 0.000000* |
| **CUSUM** | stable | stable | stable | stable | stable | unstable | stable | stable | stable | stable |
| **CUMSQ** | unstable | unstable | unstable | unstable | stable | unstable | stable | stable | unstable | stable |

Author's computation from Eviews 10

Note:*,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively

[11] ECM(-1) coefficient for J530, 560 and J580 are blank because they are not cointegrated in Appendix 5.14.
[12] ECM (-1) coefficient for J510, J520, J530 and J550 are blank because they are not cointegrated in Appendix 5.15

**Appendix 5.23 Diagnostic Test (June 1995 to June 2007) sub period**

| Variables | InJ200 | InJ203 | InJ510 | InJ520 | InJ530 | InJ540 | InJ550 | InJ560 | InJ580 | InJ590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Autocorrelation: LM test(p value)** | 0.8710 | 0.2681 | 0.6965 | 0.9007 | 0.2876 | 0.7290 | 0.1574 | 0.8184 | 0.1356 | 0.5496 |
| **Heteroscedasticity: ARCH** | 0.5504 | 0.0625*** | 0.1670 | 0.0921*** | 0.8905 | 0.6764 | 0.1323 | 0.0000* | 0.6374 | 0.7990 |
| **Normality : Jarque-Bera(p value)** | 0.000000* | 0.000000* | 0.002764* | 0.015858** | 0.000493* | 0.007565* | 0.000000* | 0.000001* | 0.000000* | 0.000000* |
| **CUSUM** | unstable | unstable | unstable | unstable | stable | unstable | stable | stable | stable | stable |
| **CUMSQ** | stable | stable | unstable | stable | unstable | stable | stable | unstable | unstable | unstable |

Author's computation from Eviews 10

Note: *,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively

**Appendix 5.24 Diagnostic Test (July 2007 to December 2018) sub period**

| Variables | InJ200 | InJ203 | InJ510 | InJ520 | InJ530 | InJ540 | InJ550 | InJ560 | InJ580 | InJ590 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Autocorrelation: LM test(p value)** | 0.3193 | 0.1581 | 0.4929 | 0.9495 | 0.3869 | 0.0914*** | 0.8504 | 0.0738*** | 0.0381** | 0.0755 |
| **Heteroscedasticity: ARCH** | 0.1906 | 0.1565 | 0.0624*** | 0.0025* | 0.6748 | 0.1267 | 0.7279 | 0.9966 | 0.0044* | 0.7604 |
| **Normality : Jarque-Bera(p value)** | 0.484860 | 0.057575 | 0.097647 | 0.093037 | 0.020445 | 0.000000* | 0.081667*** | 0.986969 | 0.084050*** | 0.000000* |
| **CUSUM** | Stable | stable | stable | stable | stable | unstable | stable | stable | unstable | stable |
| **CUMSQ** | Stable | unstable | stable | stable | unstable | unstable | stable | stable | unstable | stable |

Author's computation from Eviews 10

Note: *,** and *** indicates statistical significance at a 1% , 5% and 10%, respectively