



# University of the Witwatersrand

Master of Management in Finance and Investment

Faculty of Commerce, Law and Management

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## **THE RELATIONSHIP BETWEEN MACROECONOMIC INDICATORS AND STOCK RETURNS: EVIDENCE FROM THE JSE SECTORAL INDICES**

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Thesis submitted in fulfilment of the requirements for the degree of  
MASTER OF MANAGEMENT IN FINANCE AND INVESTMENT

Date of submission:  
**27<sup>th</sup> February 2017**

## **DECLARATION**

I, Cebisa Siphesihle Dlamini, Student number: 687076, do declare that, this thesis is wholly my own work and does not make use of another student's previous work, authors whose work was used in the text acknowledgment was given and reference was made.

Signed by \_\_\_\_\_ on this 27<sup>th</sup> day of February 2017.

## **ACKNOWLEDGEMENTS**

I would like to express my deepest gratitude to my family and friends who supported me through this academic journey. I would not have been able to complete the course without your contributions. Thank you.

I am deeply grateful to Professor Paul Alagidede, my supervisor. Thank you for your guidance and advice which helped me work harder. It would not have been possible to complete my research in time without your support. Thank you.

## **Abstract**

This study investigates the causal relationship between selected macroeconomic indicators (inflation, industrial production, South African (SA) short term interest rate, United States (US) short term interest rate) and the Resources, Financials and Industrials sectoral indices of the Johannesburg Stock Exchange (JSE) using monthly data over the period January 2002 to January 2016. The Granger-causality test is used to determine whether a causal relationship exists between the macroeconomic indicators and the sectoral indices. The results found the following: a uni-directional causal relationship from the Resources index to the US short term interest rate; a uni-directional causal relationship from the Financials index to the SA short term interest rate and the US short term interest rate; and a uni-directional causal relationship between the Industrials index and inflation, Industrials index and US short term interest rate, Industrials index and SA short term interest rate, Industrial production and the Industrials index.

Further, the results show that only the SA short term interest rate and gold price jointly impact the Resources index, negatively and positively, respectively. Also, SA short term interest rate and US short term interest rate have a negative and positive joint impact the Financials index. Inflation, industrial production and gold price are restricted in the multiple regression model. These findings have important implications for managing resources and the macroeconomy.

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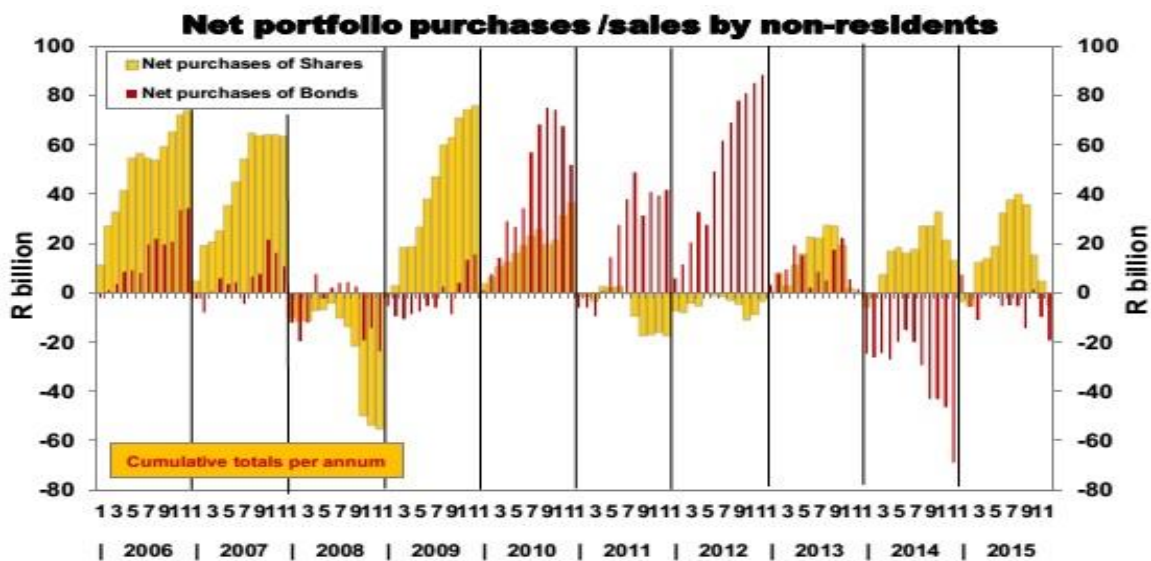
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# Chapter One

## Introduction

Over the past few decades the South African economy has endured inconsistent periods of stability. Yet, the country has continued to be an investment destination for foreign investors due to its global competitiveness, easy access to markets and efficiency. Figure 1 below shows the foreign appetite towards South African equities and bonds, between 2006 and 2015. There was a high volume of shares traded before the 2008 financial crisis. The recovery of the bond market shows the foreign investor's caution towards the South African equities after the 2008 financial crisis.

Figure 1: Value of shares purchased by foreign investors



Source: IDC, compiled from SARB and JSE data

This is achieved by ensuring a healthy and positive growth of the South African economy through improved regulatory frameworks and implementing liberal economic policies. Which have been essential in creating a conducive investment

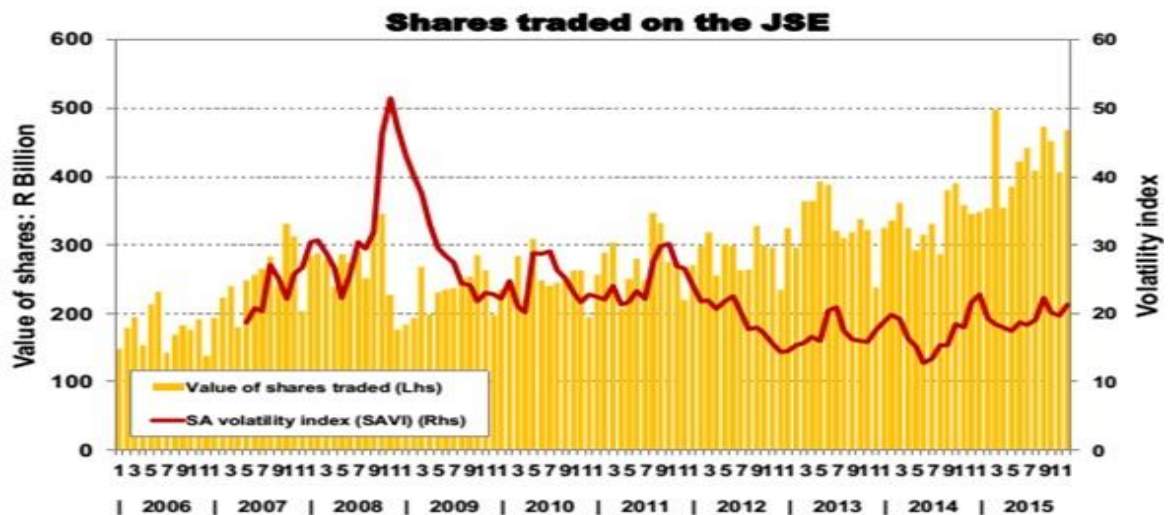


climate by stabilisation of economic conditions, lowering users' cost of capital and controlling real exchange rates (Faulkner and Loewald, 2008).

Since sanctions were lifted in 1994, South Africa's macroeconomic policy has been to ensure that the economy takes advantage of the reintegration with global economies; drawing capital into the country and creating demand for South African products. Policies such as the Growth, Employment and Redistribution (GEAR) plan were introduced with the aim of macroeconomic stability for economic growth. The GEAR plan was aimed at attaining fiscal reform, restructuring of the public sector and ensuring consistent monetary policy (Faulkner and Loewald, 2008).

These attributes have seen the Johannesburg Stock Exchange (JSE) consistently develop and becoming Africa's most efficient exchange. Figure 2 shows that between 2006 and 2015 the value of shares traded on the JSE have been consistently increasing. The fluctuating volatility index is due to concerns over the uncertainty of the South African economy in the short to medium term performance.

**Figure 2: Value of shares traded on the JSE between 2006 and 2015**

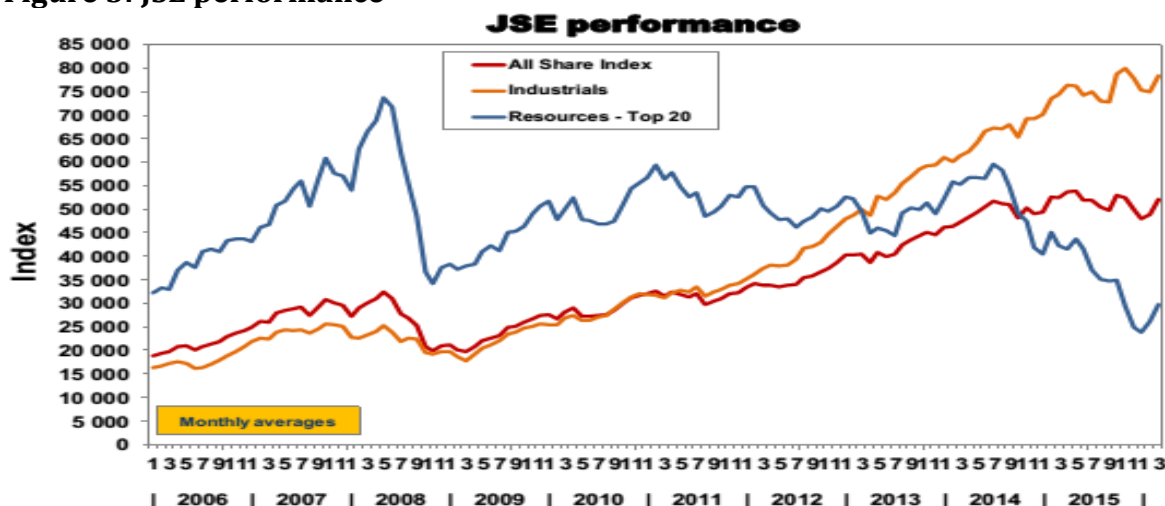


Source: IDC, compiled from SARB and JSE data

The JSE has been able to provide an infrastructure of international standards, to ensure that the public and private sector have access to capital, which is then used to improve businesses, increasing employment and ensure that government is able to address socio-economic issues in the country.

Recently, market participants have seen fluctuations in their value of wealth due to stock market volatility as seen in figure 2. The drought of 2015 which impacted the agricultural output has caused inflationary pressures on food prices rising from a low of 4.3% in June 2015 to 8.8% by February 2016. The worsening inflation outlook saw the Monetary Policy Committee (MPC) raise the repo rate in 2015 by 50 basis points. Further, the economic outlook worsened due to rising interest rates, weak demand conditions, and industries having spare production capacity, which in turn, decreased the business sector confidence and affecting investment decisions. These economic issues then filter into the stock market causing market volatility. The performance of the JSE is shown in figure 3 which clearly shows the volatility of the All Share, Industrial and Resources indices between 2006 and 2015.

**Figure 3: JSE performance**



Source: IDC, compiled from SARB and JSE data

Thus, in a bid to manage macroeconomic factors, policy makers must take into account the consequences that these controls will have on the stock market returns. Since the economy benefits from domestic and foreign capital flows drawn by the JSE.

It is clear that economic factors influence the pricing of stocks, which in turn, affects the ability of individual investors and corporates to realise positive returns. Therefore, when analysing macroeconomic indicators in relation to stock market returns it is expected that there exists a relationship and causality between macroeconomic indicators and stock prices. If a strong relationship is found it would indicate the importance of macroeconomic indicators in the process of making investment decisions.

To magnify the importance of the linkages between macroeconomic indicators and stock market prices, this study examines the relationship with JSE sectoral indices; Resources, Financials and Industrials. This is because macroeconomic indicators will affect the sectoral indices differently, also, understanding this relationship is important for companies embarking on capital projects within these sectors.

## **1.1 Problem statement**

The modelling of financial markets and asset prices is of interest in macroeconomics, especially in analysing consumption and investment decisions (Fischer and Merton, 1984). This link between finance and macroeconomics, particularly, the stock market and macroeconomic indicators is the focus area of this paper.

Increasing inflation, which was at 5.8% in the beginning of 2016, caused the rise of interest rates by 50 basis points and the real exchange rate of the rand weakened in 2015 and stood at 9.7%. These factors resulted in the slow growth of the economy to 1.3%. Further, they affected the manufacturing and agricultural sectors

negatively with the mining sector rising slightly, although, still affected by lower commodity and operational prices.

There is a lot of research on the relationship between the aggregate macro economy and aggregate stock prices (see Chen et al. (1986), Naka et al. (1998), Stock and Watson (2003), Humpe and Macmillan (2009), Sahu (2015) and Shawtari et al. (2015)). Chen et al. (1986) suggest that the presence of exogenous factors cause the co-movements of stock prices, this is consistent with the results of similar studies such as, Shawtari et al. (2015) and Ali et al. (2010).

However, we are unaware of studies examining the relationship between sectoral indices and macroeconomic performance. Given the interconnectivity of economic factors and stock market returns, the wealth of society is intrinsically linked to the fortunes of the financial and real economy.

Understanding the effect that changes in macroeconomic indicators have on the JSE sectoral performance may assist investors to predict stock price trends which can be useful in making key business decisions.

Understanding this relationship would be essential for venture capitalists assessing the eligibility of a company in their portfolio going public as an exit strategy. If information revealed by the economy indicate that there will be movement of key macroeconomic indicators and the stock price of companies in the sector of their company is usually affected by these movements, then the venture capitalist firm could re-evaluate its timing of exit.

Thus, understanding the interlinkages between macroeconomic indicators and stock market returns, by examining the magnitude and extent of changes in macroeconomic indicators to stock returns, is of importance to the private sector as it assists in making investment decisions. Such a study would offer useful

information in making accurate investment decisions and detecting early signals of economic distress.

## **1.2 Research Objectives**

The objective of the study is to investigate the extent and nature of the interconnectivity between macroeconomic factors and stock market returns. This study seeks to provide some insight into the role macroeconomic indicators play in the volatility of stock market returns.

The study will examine this relationship using the Resources, Financials and Industrials indices. The questions that the study seeks to answer are:

1. What is the impact of the selected macroeconomic indicators on the sectoral indices?
2. Are the sectoral indices more sensitive to US interest rates than domestic interest rates?
3. Is there a causal relationship between the JSE sectoral indices and inflation, industrial production, the domestic and US interest rate and the gold price?

To answer these questions a regression analysis and a Granger-causality test is used to examine how the macroeconomic indicators affect the sectoral indices.

Relevant literature regarding this topic is reviewed to lay-out the necessary theoretical foundation. The relationship between stock returns in different countries and a wide range of macroeconomic indicators will be the main theme of the theoretical discussion. The theoretical interpretation of the results found from this discussion will provide a basis for the empirical results of this paper. The empirical research will try to assess which macroeconomic indicators should be of importance to investors. After a discussion of the empirical results this study will conclude if macroeconomic indicators affect performance of sectoral indices.

## **Chapter Two**

### **Literature Review**

#### **2.1 Introduction**

Financial theory suggests that generally there is a relationship between macroeconomic variables and stock market returns. This is evidenced by the significant amount of literature available which has studied this relationship (see Chen et al. (1986), Humpe and Macmillan (2009), Naka et al. (1998), Stock and Watson (2003)). Studies have also investigated this relationship for stock markets in Africa (see Addo and Sunzuoye (2013), Barnor (2014), Shawtari et al. (2015)).

A study of the relationship between macroeconomic variables and stock market returns is important, this is especially true for investors with an interest in listed securities to fully appreciate the fundamental impact of macroeconomic variables on stock returns. This literature review will examine macroeconomic variables and the influence they have on global financial markets.

This chapter first reviews the theoretical background of macroeconomic variables and their impact on the pricing of stock prices. The Efficient Market Hypothesis, present value theory and Arbitrage Pricing Theory are briefly examined. Then the chapter reviews the existing empirical studies conducted in developed markets on the relationship between macroeconomic variables and stock returns. Thereafter, evidence of literature from developing markets is discussed.

#### **2.2 Theoretical Background**

The financial theory which supports the notion that macroeconomic variables influence stock market returns is based on the following models; the Efficient Market Hypothesis, the present value model and Arbitrage Pricing Theory.

Fama (1970) states that a key role of the capital market is to ensure that ownership of the economy's resources are fairly allocated. That is, a capital market where market prices accurately reflect the economic volatility; such that, corporates can make strategic business decisions and investors can make investing decisions on assets which contain all economic information. Such a market is said to be efficient. The efficient markets model says that the conditions of market equilibrium can be stated in terms of expected returns and that the relevant information set is fully utilized by the market in forming equilibrium expected returns and thus current prices (Fama, 1970). Thus, the model implies that new information is the underlying driver of equity prices. Theory views the efficient market hypothesis in three forms, that is; weak-form, semi strong-form and strong form efficiency. Their classification is dependent on the type of information factored into equity prices.

The present value model (or the constant growth dividend discount model (DDM)) is the second theoretical model discussed. The study by Payne et al. (1999) points out that the valuation measure determined by the DDM reacts to the variations in required return on investment and the growth rate in earnings and dividends. The author's further state that in valuation analysis the aim should be to ascertain a range for the stock price intrinsic value. This is because once the mathematical and economical elements are factored into the model then implementation of the DDM requires more than determining a single estimate. Smith (1925) gives the present value model as:

$$P_{i,t} = \sum_{n=1}^{\infty} \frac{E(D_{i,t+n})}{(1+k_i)^n} \quad (2.1)$$

Where  $P_i$  is the estimated share price,  $E(D_{i,t+n})$  is the dividend payment expected in the next period and  $(1+k_i)^n$  the discount factor with  $k$  the required rate of return. The intrinsic value of the stock price can be determined using equation (2.1) by setting  $t=0$  then the equation becomes:

$$P_{i,t} = \sum_{n=1}^{\infty} \frac{E(D_{i+n})}{(1+k_i)^n} \quad (2.2)$$

Equation (2.2) allows the estimation of the share price by calculating the present value of the future dividends.

An assumption of this model which has led to its extensive application is that dividend and the required rate of return are fixed (Payne et al. 1999). When considering the fixed variables in the pricing of assets the formula is as follows:

$$P = \sum_{t=1}^n \frac{D}{(1+R)^t} + \frac{E(P_n)}{(1+R)^n} \quad (2.3)$$

Where E (P<sub>n</sub>) is the expected share price in year n. This pricing formula helps point out that macroeconomic variables that influence the required rate of return or future dividend will have an influence on the pricing of securities.

The Arbitrage Pricing Theory (APT) is the third theoretical model examined. As explained by Roll and Ross (1984), the APT is based on the understanding that over the long term equity prices are affected by a few systematic factors. Although, the APT recognises that a number of factors impact the daily price fluctuations of individual listed securities, it focuses on factors that influence aggregate asset fluctuations within portfolios. The authors state that non-systematic factors also affect asset returns, although, the risk presented by these factors can be diversified away. The primary source of risk for portfolio returns is systematic factors or macroeconomic factors, they determine the expected and actual returns in a portfolio. It follows that in efficient markets investors receive excess returns based on the systematic risk factors being taken on by the investment.

### **2.3 Empirical Studies on Developed countries**

A study of the impact that macroeconomic variables such as; exchange rate, inflation, interest rate and GDP have on stock prices is important for investors to gain a



deeper understanding of the influence of the macroeconomic factors. This section will explore studies which have investigated this relationship. A major short coming in the study of this relationship from existing literature, is the lack of research on the different sectors found on various stock markets and how they respond to macroeconomic pressures.

Chen et al. (1986) argue that changes in macroeconomic factors creates risks which affect stock market returns. Their study focused on identifying the exogenous economic variables which influence the stock market. Although the set of macro variables used were not exhaustive, the results show that the presence of macro variables affects stock market returns. The authors found that expected stock returns are explained by; industrial production, changes in the risk premium, and changes in expected inflation. Further, they found evidence that changes in the oil price had no effect on asset prices.

Asai and Shiba (1995) examine the impact of selected macroeconomic variables; industrial production, interest rates and inflation on the stock market in Japan. The authors test this relationship using the Toda and Yamamoto (1995)'s vector auto regressions (VAR) specification. The results of the study show that macroeconomic variables granger cause the stock market, while, there is insignificant evidence to conclude that the opposite is true. In the short-run the results show that the lagged stock market returns affects the current value, however, in the long-run the impact diminishes. The authors conclude that appropriate macroeconomic policies would be beneficial for both the real market and the stock market. Further, the Japanese government's price keeping operation would not be effective.

Stock and Watson (2003) provide a different view of this relationship. The authors suggest that due to the forward-looking nature of asset prices, they could be useful predictors of macroeconomic indicators, namely; inflation and output growth. They

examined quarterly data from 1959 to 1999 of seven developed economies (Canada, France, Germany, Italy, Japan, the United Kingdom and the United States) asset prices and studied their ability to forecast inflation and output. For comparison they selected these macro variables; real economic activity, wages, prices and the money supply to examine how they compare as predictors of inflation and output. They found that asset prices have a statistically significant predictive content for output growth stronger than inflation or any of the selected variables.

Hondroyannis et al. (2005) studies time series data from Greece over the period 1986-1999. The authors examine the relationship between the development of the banking system, the stock market and economic performance. Using VAR models the authors found that a bi-directional relationship exists between finance and growth over the long-term. The Error Correction Models suggest that in the long-run both bank and stock market financing can promote economic growth, even though, the effect is not significant. Stock market finance has a lesser impact on economic growth than bank finance.

Chaudhuri et al (2004) employ the multivariate co-integration method to study the long-run relationship between real stock prices and the following selected macroeconomic variables; real GDP, real private consumption, real money and the real price of oil in the Australian market. The authors found that stock market returns are related to small departures from the long-run relationship and to changes in real macroeconomic activity. It was also found that the information provided by the co-integration has other information which is not found in the other sources of variation which include; term spread, future GDP growth or shocks to term spread. Further, it was noted that other markets such as, the US and New Zealand significantly affects the Australian stock returns.

Gan et al. (2006) study the changes that seven macroeconomic variables have on the New Zealand stock market performance. Using data ranging over the period 1990-2003 the authors employ the co-integration tests, particularly, the Johansen maximum likelihood and granger causality test. They approached this study by attempting to ascertain the leading macroeconomic variable. Further, they study the short run dynamic linkages between New Zealand stock returns and macroeconomic variables, they utilize innovative accounting analyses. The results suggest that interest rate, money supply and real GDP lead the New Zealand stock returns. They also found no evidence to suggest that the New Zealand stock returns leads macroeconomic variables.

In line with the study by Chen et al. (1986), Humpe and Macmillan (2009) performed a comparison between US and Japan stock prices and their reaction to movements in macroeconomic variables. The authors applied a co-integration analysis to US and Japan stock prices and found that the US data is consistent with a single co-integrating vector, where stock prices are positively related to industrial production and negatively related to both the consumer price index and long term interest rate. However, for the Japanese data the authors found two co-integrating vectors. They found that for one vector, stock prices are positively influenced by industrial production and negatively by the money supply. For the second co-integrating vector they found industrial production to be negatively influenced by the consumer price index and long term interest rate. The difference in behaviour could be explained by the Japanese market decline after 1990 and the liquidity trap that followed in the early 2000s (Humpe and Macmillan, 2009).

Yang et al. (2008) use the super endogeneity method to investigate the causal relationship between financial development and economic growth using annual Korean data over the period 1972-2002. The authors selected this data because it captures a period in which Korea experienced phenomenal economic growth and

different financial liberalization and reforms. The results of the study show that a unidirectional causal relationship exists with financial development being the leading variable. There is significant evidence to show that finance leads growth in Korea as opposed to growth leading finance. The authors conclude that policy makers in Korea should priorities financial reform and not economic growth, increased strides towards financial reform will ensure sustainable growth over the medium to long term.

Kishor et al. (2009) documents the changing impact of selected macroeconomic variables on stock market returns in the US. The authors selected a sample containing monthly observations from 1970 to 2004, they test the impact using a monthly and yearly time frame. The results show that on a monthly basis the impact of macroeconomic variables changes significantly from less than 1 percent of variance in stock market returns, whereas, it changes by 84 percent on yearly basis. It is also found that lagged industrial production and inflation have significant impact on stock returns, while, brand monetary aggregate and federal funds rate have an insignificant impact.

Antonios (2010) uses the vector error correction model (VECM) to study the relationship between stock market development and economic growth for Germany the author seeks to investigate the causal relationship using data over the period 1965-2007. Using the Johansen co-integration test and unit root test, the authors also investigates the long-run relationship between the stock market development and economic variables. It was found that there exists a unidirectional causality between stock market development and economic growth.

Sariannidis et al. (2010) investigates the influence of selected macroeconomic variables on the Dow Jones sustainability (DJSI) and Dow Jones Wilshire 5000 indexes. The authors use monthly data over the period 2000 to 2008 they also

employ the GARCH model to test this impact. The findings of the study show that changes in crude oil prices negatively affect the US stock market, while movements in the 10 year bond value positively affects the US stock market. The authors also found that the crude oil prices and 10 year bond impact the DJSI with a month delay. Further, they found evidence that exchange rate volatility negatively impacts US stock market returns and the non-farm payroll is found to be a stability factor for the DJSI.

In Europe Barbic and Condic-Jurkic (2011) conducted a study which aimed at investigating the presence of informational inefficiencies on stock markets of Croatia, Czech Republic, Hungary, Poland and Slovenia by examining the influence macroeconomic variables have on stock market indices. The authors employ the Johansen co-integration test to investigate this relationship, with the following selected variables: inflation rate, broad money supply, money market interest rate and foreign currency reserves. The Granger-causality test was used to identify the causal direction in these markets. The results of the study show that there is a long-run relationship between stock returns and macroeconomic variables, this long-run relationship is strong in Poland and Czech Republic. The Granger causality test reveal: that no causality exists between any macroeconomic variables and the Croatia stock market index; there is a unidirectional relationship between money supply and foreign exchange and Czech Republic stock index, whereas, a unidirectional relationship exists between inflation and money market interest rate and the Slovene stock index; the relationship between the stock market index and money market interest rate in Hungary and Czech Republic is unidirectional; lastly, in Slovenia and Poland these indices lead foreign exchange reserves and money supply.

While Chen et al. (1986) and Stock and Watson (2003) argue macro variables influences stock prices and that asset prices predict macro variables respectively.

Further research conducted in this field, some of which reviewed in this chapter, has managed to examine the nature and direction of this relationship over different time periods.

There is a substantial amount of research conducted in this field focusing on developed markets, what remains to be explored in depth is the case of developing markets. The next section will focus on empirical studies in developing markets.

## **2.4 Empirical Studies on Developing countries**

In developing markets there has been an increase on the research conducted investigating the relationship between macroeconomic variables and stock prices.

Naka et al. (1998) tested the VECM model with data from the Indian stock market between 1960 and 1995. The authors analysed relationships among selected macroeconomic indicators and the Indian stock market. They found that three long-term equilibrium relationships exist among these indicators. Further, the results indicate that industrial production is the largest positive determinant of the stock price, while inflation is the largest negative determinant. Among the most popular macroeconomic indicators used to examine this relationship are: inflation, money supply, interest rates, industrial production, and exchange rates as demonstrated by Chen et al. (1986), Humpe and Macmillan (2009).

Ray et al. (2003) studies the relationship between the real economic variables and the Indian capital market. Using monthly data between 1994 and 2003 the authors investigate the influence of the following variables; national output, fiscal deficit, interest rate, inflation, exchange rate, money supply, foreign institutional investment on the Indian market (Bombay stock exchange). Applying non-linear models like VAR and Artificial Neural Network, the authors find that some variables like the interest rate, national output, money supply, inflation and the exchange rate have a

positive impact on the stock market. While, the other variables have an insignificant impact on the stock market.

A study of the BRIC (Brazil, Russia, India, and China) markets was conducted by Gay (2008), using the Box-Jenkins ARIMA model to evaluate the relationship between those stock market indices and the foreign exchange rates and oil price. The study uses monthly averages of stock returns, foreign exchange rates and oil price ranging between 1999 and 2006. The author finds that there is no significant relationship between foreign exchange rate and oil price on stock market index prices on either country. This result suggests that other domestic and international variables influence stock prices.

Garza-Garcia and Vera-Juarez (2010) tested the impact of foreign (Chinese and American) macroeconomic variables (industrial production and interest rates) on stock returns of Latin American countries (Brazil, Chile and Mexico) where they applied the present value model. This study tests the Johansen co-integration test and the VECM model. The authors found that foreign variables are co-integrated with Latin American stock returns. They also found that the US macroeconomic variables granger-cause the Mexican and Brazilian stock returns, whereas, the Chinese macroeconomic variables granger-cause Mexican and Chilean stock returns. This shows the influence that the US and Chinese economies have on Latin America, thus, investors in Latin America should focus on the foreign macroeconomic variables when making investment decisions.

Ali et al. (2010) test the Johansen co-integration and Granger causality test, to examine the relationship between macroeconomic indicators (money supply, index of industrial production, exchange rate, inflation and balance of trade) and stock exchange prices in Pakistan with data ranging from June 1990 to December 2008. They found a co-integration between industrial production index and stock

exchange prices. However, no causal relationship was found between macroeconomic indicators and stock exchange prices in Pakistan.

Maku et al. (2010) investigate the influence that macroeconomic variables have on stock market returns in Nigerian, the study is focused on assessing the long-run relation using data over 1984 to 2007. To examine the time series data the authors employ the Augmented Dickey Fuller (ADF) unit root test and found that the data had a unit root. Using the augmented Engle-granger co-integration test the results suggest that in the long-run macroeconomic variables influence stock market returns. Empirical evidence shows that the Nigerian stock market returns respond more to exchange rate, inflation, money supply and real output. The selected variables were found to influence the Nigerian capital market performance simultaneously in the long run. The authors conclude that in the long run investors should observe exchange rate, inflation, money supply and economic growth when making investment strategies as opposed to Treasury bill rate.

Xiufang Wang (2010) investigates the impact of macroeconomic variable volatility to stock prices in China. The author uses the exponential generalized autoregressive conditional heteroscedasticity (EGARCH) and lag-augmented VAR (LA-VAR) models on time series data to examine this relationship. The results show that there exists a bilateral relationship between inflation and stock prices, there is a unidirectional relationship between interest rates and stock prices with stock prices leading interest rates. The study also found that there was no significant relationship between stock prices and real GDP. The author concludes that the Chinese market is not as efficient as the U.S and other developed markets and there appears to be no link between these economies and the real economy of China.

Xu (2011) seeks to study the relationship between stock prices and exchange rates in Turkey using the Granger causality test from 2001 to 2008. The author selected



this period because it was during a period where the exchange rate regime was determined as floating. The stock prices used in the study were from the national 100, services, financials, industrials and technology indices. The results of the study show that a bidirectional relationship exists between exchange rate and all the stock market indices. While, there is sufficient evidence to show that there is a negative relationship from national 100, services, financials and industrials indices to exchange rate. The results also show that a positive relationship exists between technology indices and exchange rate, where the technology indices leads exchange rate. However, the exchange rate and stock market indices have a negative relationship led by the exchange rate.

Tripathy (2011) uses the Granger causality test to examine the causal relationship between the Indian stock market and selected macroeconomic variables using data ranging from 2005 to 2011. They found that there is a bidirectional relationship between; interest rate and the Indian stock market, exchange rate and Indian stock market, international stock market and Indian stock exchange volume, exchange rate and Indian stock exchange volume. The author also found a unidirectional causality running from international stock market to; domestic stock market, interest rate, exchange rate and inflation rate.

Addo and Sunzuoye (2011) used the Johansen multivariate co-integration test and the VECM to study the joint impact that interest rates and Treasury bill rate have on the Ghana stock returns. Using data over the period between 1995 and 2011, the authors found that the Ghana stock market returns are co-integrated with the interest rates and Treasury bill rate. They found that both the Treasury bill rate and interest rate have a negative relationship with stock market returns but are not significant. Indicating that interest rate and Treasury bill rate have both negative relationship but weak predictive power on stock market returns independently.

Thus, leading to the conclusion that interest rate and Treasury bill rate jointly impact on stock market returns in the long run.

Asaolu and Ogunmuyiwa (2011) use the augmented dickey fuller (ADF) test, Granger causality test, Co-integration and Error Correction Method (ECM) on Nigerian time-series data ranging over 1986-2007. The study examines the influence of macroeconomic variables on the Average Share Price (ASP) and for completion the authors further investigate if changes in macroeconomic variables impact movements in stock prices. The results of the study show that there is a weak relationship between ASP and macroeconomic variables. They also found that ASP does not lead macroeconomic performance. Although, there exists a long-run relationship between ASP and macroeconomic variables.

Adaramola (2011) considers a study of Nigerian data over the period 1985 and 2009, investigating the impact of six macroeconomic variables (money supply, interest rate, exchange, inflation rate, oil price and GDP) on the stock returns of selected firms. The authors used the pooled or panel model to assess the impact that variables have on stock prices of the firms. The results show that the impact of selected variables has different levels of significance on stock prices of individual firms. The selected variables have a positive impact on stock returns with the exception of inflation and money supply.

Olweny and Omondi (2011) use monthly data of a 10 year period between 2001 and 2010 to test the Exponential generalised autoregressive conditional heteroscedasticity (EGARCH) and Threshold generalised conditional heteroscedasticity (TGARCH) by examining the effect of macroeconomic variables on stock market return variation in Kenya. Olweny and Omondi (2011) selected the foreign exchange rate, interest rate and inflation rate and investigated their impact

on stock market variation. The results of the study find that the selected variables affect stock market return volatility.

Another study examining the causal relationship in India was done by Ray (2012). The author uses a multivariate Granger causality to assess the existence of a causal relationship between stock prices and macroeconomic variables in India. Using annual data from 1991 to 2011, the author found no causal association between stock prices and interest rate, and index of industrial production which contradicts the study by Tripathy (2011) but there exists a unidirectional causal association between stock prices and inflation, foreign direct investments, GDP, exchange rates and gross fixed capital formation. The author also found a bi-directional causality between stock prices and foreign exchange reserves, money supply, crude oil, whole price index. The finding of inflation having a positive influence on stock prices is a contradiction to the results found by Naka et al. (1998), this could be due to the difference in the methods employed by the authors and the different data samples.

Using the augmented dickey fuller unit root test, Johansen co-integration test, Granger causality test and the VECM model Patel (2012) examines the impact of selected macroeconomic variables on two stock market indices of the Indian stock market. The data sample ranges between 1991 and 2011 the author uses the following variables; interest rate, inflation, exchange rate, industrial production, money supply, gold price, silver price and oil price. The results show that there is a long-run relationship between exchange rate and stock returns, while, the stock returns have a unidirectional relationship with industrial production and oil price.

Another study in India was done by Naik and Padhi (2012) using the Johansen co-integration and VECM model to examine the long run equilibrium relationship between the Indian stock market index (BSE Sensex) and selected macroeconomic variables (industrial production, wholesale price index, money supply, Treasury bill

rate and exchange rates). The results find that there is a co-integration relationship between the stock market returns and macroeconomic variables, thus, there exists a long run equilibrium relationship. Further, it was observed that there is a positive relation from stock prices to money supply and industrial production but a negative relation with inflation. The exchange rate and short term interest rate fail to determine stock prices. When using the Granger causality test it is found that macroeconomic variables granger cause the stock prices over the long run but fails in the short run. Also, industrial production and stock prices have a bidirectional causal relationship, whereas; money supply and stock prices, stock prices and inflation, interest rates and stock prices have a unidirectional causal relationship.

Osamwonyi and Evbayiro-Osagie (2012) use the following macroeconomic variables: interest rates, inflation rates, exchange rates, fiscal deficit, GDP and money supply to investigate their impact on the Nigerian capital market index. The authors use the VECM model with data between 1975 and 2005 to examine the short and long run relationship between the variables and the Nigerian capital market index. Consistent with expectations it is found that macroeconomic variables have an influence on the stock market index.

In Ghana, Kuwornu (2012) employed the Johansen multivariate co-integration procedure to monthly data between 1992 and 2008. The author found that inflation is the most influential macroeconomic variable influencing the stock returns in the short and long run. The results further state that in the short run there is no compensation for increases in inflation but in the long run investors are compensated. Also, the results show that the Treasury bill rate and inflation the stock returns in the short run.

Hsing et al. (2013) study the Mexican stock market index in relation to its domestic macroeconomic variables (real GDP, exchange rate, M3/GDP ratio, interest rate,

government deficit/GDP ratio and expected inflation). The authors test this relationship using an exponential GARCH model with a sample over the period 1985 to 2011. The results of the study found that the stock market index is positively associated with GDP, the exchange rate, the M3/GDP ratio and there is a negative association between US stock market index and interest rate, government deficit/GDP ratio and expected inflation. These results suggest that a higher US stock market and peso depreciation improved performance of the Mexico stock index. The peso depreciation could result in a decline of the economic performance as this would see capital outflow.

Forson and Janrattanagal (2013) selected the following macroeconomic variables: money supply, consumer price index (CPI), interest rates and industrial production to examine the long-run relationship with the Thailand stock market index. They found that there exists a co-integration between the market index and the selected macroeconomic variables, they also found a significant long-run relationship exists. Further, they discovered that there is a significant positive relationship over the long-run between money supply and market returns. In relation to industrial production index and CPI there is evidence of a negative long-run relationship with the market index. In the non-equilibrium case, the error correction mechanism shows that the CPI, industrial production and money supply attempt to restore equilibrium. A bidirectional causality was found between industrial production and money supply, a unidirectional causality was found between; CPI and interest rate, industrial production index and CPI, money supply and CPI, industrial production and the market index this was tested using the Toda and Yamamoto augmented Granger-causality test. This shows that the Thailand stock market movements influences these variables.

Using panel data of generalised least squares regression method Miseman et al. (2013) investigate the impact of four macroeconomic variables (interest rate, broad

money supply, domestic output and inflation rate) on five ASEAN (Malaysia, Indonesia, Thailand, Singapore and the Philippines) stock market volatility. The results indicate that there is a strong and significant influence of interest rate, broad money and inflation rate on ASEAN stock market variation, whereas, the domestic output has an insignificant impact on the stock market movements, this contradicts the study by Forson and Janrattanagal (2013).

Issahaku et al. (2013) applies the VECM model using stock returns in Ghana with monthly data over the period 1995 to 2010. Issahaku et al. (2013) studies the short and long run relationship between stock market returns and macroeconomic variables. Further, the authors use the Granger causality test to investigate the direction of the relationship. They also used the Impulse response functions and forecast error variance decomposition to test stability of the relationship over time. The results of the study show that there exists a long run relationship between stock returns and inflation, money supply and foreign direct investments (FDI). While a short run relationship exists between stock returns and interest rate, inflation and money supply. There exists a unidirectional causal relationship between stock returns and money supply, interest rates and FDI.

Alam (2013) used a factor model on two time intervals pre and post the global financial crisis of 2007 to study the change in relationship between macroeconomic variables and stock market returns. Alam (2013) uses stock returns of Malaysia, Indonesia, Singapore and Thailand they found that the relationships were not consistent in terms of significance over the two periods between the macroeconomic variables and the stock returns. The study uses exchange rate, term structure, money supply and oil price. Post crisis the stock markets were more responsive to oil price movements. Thailand has a positive correlation between inflation and stock market returns. While in the pre-crisis, Malaysia and Indonesia documented a negative correlation between inflation and stock returns.

Teker and Alp (2014) test the Granger causality method to investigate the causal relationship between interest rates and the stock market indices of the following emerging markets: Turkey, Brazil, China and Hungary. The authors use data consisting of T-Bills and T-Bonds of different maturities as well as the stock market indices. The different maturities allow the authors to assess investor behaviour in respect to risk and time length. The results of the study show that there is a causal relationship between the Hungary stock market and interest rates, whereas, in the Chinese stock market the causality is weaker. The results show that all the stock market indices granger-cause the 3 month T-Bill rate with the exception of the Brazilian stock market index. In Turkey and Brazil they found that the 6 month T-Bill rate granger-cause their stock returns but the Chinese and Hungarian index granger-causes the 6month T-Bills.

Venkatraja (2014) conducted a study with the aim to investigate the impact of selected macroeconomic variables (industrial production, wholesale price index, gold price, foreign institutional investment and real effective exchange rate) on the Indian stock market returns with monthly data over the period 2010-2014. The results of the study were found using a multiple regression method. The authors found that there is a significant influence by the independent variables on the Indian stock market (Sensex). The following variables had a high degree of positive impact on the Sensex, wholesale price index, industrial production, foreign institutional investment and real effective exchange rate. Also, movements in gold price inversely affect the Sensex with the exception of industrial production. All the other variables are statistically significant.

Another study was conducted for the case of Pakistan by Hunjra et al. (2014) to study the impact that interest rate, exchange rate, GDP and inflation have on stock prices in Pakistan. Using the Granger causality and Johansen co-integration tests on monthly data over the period 2001 to 2011, the authors find that in the short run

there is no relationship between the macroeconomic variables and stock prices. In the long run, however, it is found that a relationship exists.

Ouma and Muriu (2014) conducted an interesting study on the relationship between macroeconomic variables and stock returns using the asset pricing theory and capital asset pricing model in Kenya using monthly data over the 2003 and 2013 period. To test the influence of the selected variables on the stock returns, the authors apply the ordinary least squares (OLS) technique. The results of the study show that there is a significant relationship between stock market returns and macroeconomic variables, with the exception of interest rates. Money supply, exchange rates and inflation are found to influence the stock market returns in Kenya. While money supply and inflation are found to lead the stock returns in Kenya. Finally, exchange rates have a negative impact on stock returns.

Using the Johansen multivariate co-integration test and vector error correction model Ibrahim et al. (2014) study the impact of macroeconomic variables on stock market returns using data from September 2000 to September 2010. The results show that there is a long run relationship between the stock returns and broad money supply, inflation, exchange rate, index of industrial production and interest rate. In the short run it is found that stock returns are significantly affected by exchange rate and interest rate. Also, industrial production has a negative impact on the stock returns.

Mamipour et al. (2015) studied the impact of oil and gold prices on the stock market in Iran. The authors used the co-integrated vector autoregressive Markov-switching model to investigate the interaction of the prices with the stock market with data ranging over the period January 2003 to December 2014. The data was characterized into the following groups: “deep recession”, “mild recession” and “expansion”. The study finds that the oil price has a positive and significant effect on



the stock market returns in the short run. Although, in the long run it has a negative effect. The impact of the gold price on the other was found to vary during this period due to the different market conditions. In the short run (10 months) the positive gold price resulted in the decrease of the stock market returns, while in the medium to long term it led to an increase in the stock market returns.

Sahu (2015) uses data from April 1993 to March 2013 to investigate the short and long run relationship and the causal relationship between the stock prices and selected internal (inflation rate, interest rate, money supply, index of industrial production, gold price and foreign exchange reserve) and external (crude oil price, exchange rate, foreign institutional investments, foreign trade, and US S&P 500 stock index) macroeconomic indicators in India. The uses various VAR models to examine this relationship such as; Granger causality test, VECM model, Johansen co-integration test, Impulse response analysis and variance decomposition. The results show that in the long run macroeconomic indicators have an impact on the stock prices. While, in the short run the stock prices are influenced by only CPI, foreign trade and exchange rate. The multiple regression analysis suggests that there in the long run there is no long run causal relationship among the variables. Although, there exists a bi-directional relationship variables and the stock market. The Granger causality test shows that there is a short run and uni-directional relationship between the CPI and stock prices, it also found that there exists a bi-directional causal relationship between stock prices and the exchange rate and foreign trade. It was also found that stock prices react more to shocks in stock prices, as reported by the variance decomposition analysis and the impulse response function analysis. The author states that the in the long run Indian stock market is informationally

Kothari et al. (2015) use the Granger causality test to investigate the relationship between the gold price and the stock market index in India with data between 1979

and 2013. A positive correlation is found between the gold price and stock returns. The results from the Granger causality test show that there is a unidirectional causal relationship from the stock market returns to the gold price. The authors conclude that over the long run investors should invest in the stock market rather than gold.

Shawtari et al. (2015) used the South African stock market to study the long-term equilibrium between the stock returns and selected macroeconomic indicators. Using the VECM model the authors found that industrial production, inflation, money supply, and exchange rate are co-integrated on the long-run with stock prices. However, of the selected variables industrial production was found to have the biggest influence on the stock returns.

A substantial amount of research conducted for developing markets has been fairly recent, however, there has been a few studies which extend this study to the sectoral markets. This provides motivation to explore this relationship at a sectoral level and study the reaction of the different economic sectors to changes in macroeconomic factors.

The literature reviewed has different results from one author to another. Some results show that there is a significant positive relationship between macroeconomic variables and stock returns, while others report an insignificant relationship when the same variables are examined. The selected variables, period of the data selected, the developmental stage of the stock market being tested and the different methods used in the studies are some of the contributing factors to the mixed results from the literature. Further, the results of the literature also show that macroeconomic variables do not explain a significant amount of volatility of the stock markets. Also, the studies have different areas of focus, investigating the existence of a bidirectional or lead-lag relationship in either the short or long run or both.

Nevertheless, the literature suggests that changes in macroeconomic factors have an influence on the stock market returns in both the short and long term.

This chapter examined the theoretical and empirical literature which supports the existence of a relationship between macroeconomic variables and stock returns. The macroeconomic variables selected for this study: inflation, interest rate, industrial production and gold price were found to be mostly significant in the literature review. The method used in this study to identify if a causal relationship exists between macroeconomic variables and stock market returns in the JSE is supported in this chapter. Thus, the Granger causality test is modelled in chapter three of this paper.

The next chapter presents a description of the data and expected outcomes of the macroeconomic variables. It also presents the methodology and empirical framework used in this study.

## **Chapter Three**

### **Method and Description of Data**

#### **3.1 Introduction**

This chapter first describes the data collected to be tested for this study and provides the expected outcomes for the macroeconomic variables and their interactions with stock prices in South Africa. It then concludes by providing the statistical technique used to examine the relationship between macroeconomic factors and stock returns.

#### **3.2 Data sources and variable definition**

This study uses closing prices of the JSE sectoral indices. The sample of sectoral prices used is monthly data ranging over the period January 2002 to January 2016. The sectoral indices used are: FTSE/JSE Resources 20, FTSE/JSE Financials 15 and FTSE/JSE Industrials 25.

The importance of using sectoral indices is because they allow investors who lack insight about individual stock to invest using indexing as a method of selecting stocks. Also, Investors can use sectoral indices as a benchmark to compare performance of individual stock. Lastly, these indices are selected based on the three different sectors that the JSE classifies the listed instruments. The classification of these sectors is based on their revenue in the local currency. The three sectors are classified using the Industry Classification Benchmark (ICB) as follows: South African Resources, these are Oil and Gas and Basic materials companies which were derived from the ICB; South African Financials, these are financial industry companies derived from the ICB; and lastly, South African Industrials, these are all

companies which are not included in the financial, Oil & Gas and Basic materials industries.

The data sample chosen was such that it captures post-apartheid events and a financial crisis. Also, this sample was chosen to ensure the most recent data is captured. The data for this study was obtained from Bloomberg.

### **3.2.1 Macroeconomic Variables**

The variables selected are based on existing studies and relevance to the South African market. However, this study makes no claim that the variables selected are exhaustive.

The selected macroeconomic indicators for this study are: consumer price index (CPI) as proxy for inflation, industrial production, US Fed Fund as proxy for US interest rate, Interest repo average rate as a proxy for the short-term domestic interest rate, and the gold price is included because of the influence it has on the South African market, particularly, the mining sector.

### **3.2.2 Hypothesised Variable Relationships**

#### **3.2.2.1 Inflation**

The existing literature provides evidence that movements in inflation caused stock prices to react. Since inflation erodes the purchasing power of disposable income and private sector profits. Households and corporates tend to save more when inflation increases driving demand for stocks down. Further, rising inflation results in monetary policy tightening, that is, increasing of interest rates. Thus, raising the normal interest rate which leads to an increase of the discount rate used in stock valuation (Kuwornu, 2012). Thus, stock prices are hypothesized to be negatively affected by rising inflation.

### **3.2.2.2 Industrial Production**

This economic indicator measures the output of the industrial sector, which includes; mining and manufacturing. These sectors also react to movements of inflation since it reduces demand. Industrial production is measured using an index based on a reference period that expresses change in the volume of production output. Also, industrial production has an impact on stock prices since it affects expected future cash flows (Ray, 2012). As a result, stock prices are hypothesized to be positively affected by an increase in the industrial production index.

### **3.2.2.3 Interest rate**

Interest rates are an important factor in the pricing of assets. An increase in interest rates will result in a higher discount rate, negatively affecting stock prices, by enhancing the opportunity cost of holding cash resulting in investors moving towards interest bearing securities, decreasing demand for stocks (Ray, 2012).

### **3.2.2.4 Gold price**

Historically, gold has been used to hedge against market decline, which is caused by a number of factors, such as, rising inflation which diminishes savings resulting in a decline of demand for stocks. The rarity of gold ensures that its value remains the same, hence, making it more desirable in market decline. In the case of South Africa, an exporter of the commodity, capital inflows are expected when there is market volatility in foreign markets. That is, an increase in the gold price will result in an increase in the commodity market which cause a decrease in the equity market (Patel, 2012) Thus, a positive relationship is expected between stock prices and gold price.

### 3.3 Empirical Framework

This study follows a time-series design to investigate the causal linkages between macroeconomic indicators and sectoral stock prices. The Granger causality technique outlined by Granger (1969) will be used.

The study uses market data which is expected to be non-stationary. Thus, there is a need to test the data for stationarity. The importance of testing for stationarity, as given by Brooks (2008), is because when using a non-stationary time series; unexpected changes in the value of the error term will persist infinitely, it could lead to inaccurate regression results which produce spurious regressions.

The methods used to perform the analysis are; the unit root and Granger causality test which is based on the literature reviewed. The methods are described below to illustrate how they will assist analyse the relationship between macroeconomic indicators and the JSE sectoral indices.

To begin the investigation of the impact of macroeconomic indicators on the performance of sectoral indices, a linear regression model is built for each sector to examine the individual and joint impact of the macroeconomic indicators on the sectoral indices:

$$SPR = \beta_0 + \beta_1\pi + \beta_2IP + \beta_3r^f + \beta_4r^d + \beta_5GP + \varepsilon_t \quad (3.1)$$

$$SPF = \beta_0 + \beta_1\pi + \beta_2IP + \beta_3r^f + \beta_4r^d + \beta_5GP + \varepsilon_t \quad (3.2)$$

$$SPI = \beta_0 + \beta_1\pi + \beta_2IP + \beta_3r^f + \beta_4r^d + \beta_5GP + \varepsilon_t \quad (3.3)$$

Where SPR = FTSE/JSE Resources 20, SPF = FTSE/JSE Financials 15, SPI= FTSE/JSE Industrials 25,  $\pi$  = Inflation,  $r^f$  = US Fed Funds Rate,  $r^d$  = South African Interest REPO average rate, GP = gold price,  $\beta_0$  = constant, the coefficients  $\beta_i$  for  $i = 1, 2, \dots, 6$  are the

values which measure the sensitivity of each explanatory variable on the sectoral indices (Brooks, 2008).

### **3.3.1 Unit Root Test**

Prior to applying the Granger causality test a unit root test must be conducted to test for stationarity. Theoretically, a stationary series is characterised as having constant mean, variance and auto-covariance for every lag. As such, shocks to the series are eliminated and do not persist over time. Whereas, in a non-stationary time series shocks tend to have an increasing impact over time (Brooks, 2008). Thus, there is a need to detect the existence of non-stationarity using methods such as; line graphs, Ljung-Box Q statistic test and t-test statistics. However, deterministic and stochastic non-stationarity may still be present when applying these methods.

Hence the need to apply a stochastic stationarity model such as, the unit root test since it captures non-stationarity in financial and economic time series data. Most of the literature reviewed applies the unit root test method developed by Dickey and Fuller (1979). In statistical terms, a time series with a unit root is said to be non-stationary. Thus, a non-stationary time series with a unit root must be differenced once before it becomes stationary. Then it is said to be integrated of order 1, that is, I (1).

In this study, the Augmented Dickey Fuller (ADF) test is carried out to assess stationarity, Said and Dickey (1984) developed the test for general ARMA (p,q) models with unknown orders.

To illustrate the ADF, as shown by Dickey and Fuller (1979). Consider the autoregressive model  $Y_t = \rho Y_{t-1} + \varepsilon_t$ , for  $t = 1, 2 \dots$ . Where  $Y_0 = 0$ ,  $\rho$  is a real number and  $\varepsilon_t$  is a sequence of independent normal variables with mean zero and variance  $\sigma^2$ .



The time series  $Y_t$  converges (as  $t \rightarrow \infty$ ) to a stationary time series if  $|\rho| < 1$ . If  $|\rho| = 1$ , the time series with  $\rho = 1$  is sometimes called a random walk. If  $|\rho| > 1$ , the time series is not stationary and the variance of the time series grows exponentially as  $t$  increases.

The ADF test tests the null hypothesis that a time series  $Y_t$  is  $I(1)$  against the alternative that it is  $I(0)$ , assuming that the dynamics in the data have an ARMA structure. The ADF test is based on reconstructing a basic autoregressive model for higher order correlation such as

$$Y_t = \beta' \mathbf{D}_t + \phi Y_{t-1} + \sum_j^{\rho} \psi_j \Delta Y_{t-j} + \varepsilon_t \quad (3.4)$$

Where  $\mathbf{D}_t$  is a vector of deterministic terms (constant, trend, etc.). The  $\rho$  lagged difference terms,  $\Delta Y_{t-j}$  are used to approximate the ARMA structure of the errors and the value of  $\rho$  is set so that the error  $\varepsilon_t$  is serially uncorrelated.

### 3.3.2 Granger Causality Test

Asteriou and Hall (2007) states that, VAR models have the ability to test for the direction of causality. Causality in this context refers to the ability of one variable to predict the other. The relationship between two stationary time series ( $X_t$  and  $Y_t$ ), which affect each other, can be captured by a VAR model. When investigating this relationship the following outcomes are possible: (i)  $Y_t$  predicts  $X_t$ , (ii)  $X_t$  predicts  $Y_t$ , (iii) a bidirectional causal relationship exists, (iv) there is independence between the variables.

The Granger causality procedure will be employed to statistically detect the cause and effect relationship between the  $X_t$  and  $Y_t$  variables. According to Asteriou and Hall (2007) to employ the Granger causality test, the following procedure must be followed. Estimate the VAR model given by equation (3.5) and (3.6). Followed by

checking the significance of the coefficients then applying variable deletion tests, first in the lagged  $x$  terms for equation (3.5) and then in the lagged  $y$  terms in equation (3.6). The direction of causality based on the above cases will then be determined by the variable deletion tests.

To use the Granger-causality test, both the time series  $X_t$  and  $Y_t$  must be stationary. Then testing the causal relationship between the two stationary series can be based on the bi-variate auto-regressions, as shown by Granger (1969).

$$Y_t = \sum_{j=1}^m \alpha_j Y_{t-j} + \sum_{i=1}^n \beta_i X_{t-i} + \varepsilon_t \quad (3.5)$$

$$X_t = \sum_{j=1}^m \alpha_j Y_{t-j} + \sum_{i=1}^n \beta_i X_{t-i} + \varepsilon_t \quad (3.6)$$

Where  $\alpha_j$  is the coefficient on the lagged  $Y$  values and  $\beta_i$  is the coefficient on the lagged  $X$  values. Instantaneous causality is not included in the model hence the setting of  $j=i=0$ . If the null hypothesis  $\beta_i = 0$  fails then  $X$  fails to Granger-cause  $Y$ . To examine the null hypothesis of no causality an F-test is employed. For the F-test, included in the unrestricted model are lagged values of the other variable. Whilst for the restricted model only lags of the dependent variable are included.

When performing a joint test on the lags of a certain equation it is easier to use Vector Autoregressive (VAR) models since restrictions are set on parameters from the same equation (Brooks, 2008). The application of this method helps identify if changes in a particular variable ( $X$ ) causes changes in other variable ( $Y$ ) of interest. If that is the case then to better predict  $Y$ , lags of the influential variable,  $X$ , should be included in the equation of  $Y$ . Then it is said that  $X$  Granger-causes  $Y$ .

An important step in conducting VAR models such as the Granger causality, is the selection of the VAR lag order. According to Brooks (2008) there are several ways of

selecting lag order: firstly, the frequency of the data can be used; secondly, different versions of the informational criterion can be used, such as, Akaike's, Schwarz's and Hannan-Quinn information criterion.

This chapter looked at the statistical method used in this study, as well as providing a description of the process of derivation for the Granger causality technique. A description of the process of research was presented and the data collected for the macroeconomic variables and sectoral indices of the JSE was presented. The next chapter examines the empirical results from the econometric tests.

## Chapter Four

### Empirical Results and Analysis

#### 4.1 Introduction

This chapter presents the results of the tests conducted in the study. First, it presents the descriptive statistics of the stock market returns and macroeconomic indicators, then it summarizes the results of the regression analysis. The Granger causality test is then discussed to establish the causal direction between the sectoral indices and the macroeconomic indicators.

#### 4.2 Descriptive Statistics

Table 1 and Table 2 below present the descriptive statistics of the stock market returns and the indicators. The tables present results for the sample means, medians, maximums, minimums, standard deviations, skewness, kurtosis, Jarque-Bera statistics and probability (p-values) for all the selected macroeconomic indicators and the sectoral indices.

**Table 1: Descriptive statistics of stock market returns**

	<b>SPR</b>	<b>SPF</b>	<b>SPI</b>
<b>Mean</b>	33769.1910	19106.1621	21509.0901
<b>Median</b>	37525.9700	18338.2813	21260.4321
<b>Maximum</b>	73094.8000	46641.91	47939.01
<b>Minimum</b>	4180.68049	6693.6208	3371.5807
<b>Std. Dev.</b>	18126.8733	10481.6921	13826.9836
<b>Skewness</b>	-0.0528	0.9061	0.3590
<b>Kurtosis</b>	1.6812	2.9629	1.8612
<b>Jarque-Bera</b>	15.7524	29.5723	16.3115
<b>Probability</b>	0.0004	0.0000	0.0003
<b>Observations</b>	216	216	216

Note: SPR, SPF and SPI denote "FTSE/JSE Resources 20", "FTSE/JSE Financials" and "FTSE/JSE Industrials" respectively.

It can be seen from Table 1 that all the sectoral indices with the exception of the Resources index are positively skewed. Kurtosis values suggest that the Resources and Financials indices follow a platykurtic distribution and the Financials index follows a mesokurtic distribution. The Jarque-Bera statistic tests and the corresponding p-values are used to check if the data follows a normal distribution.

The results of the Jarque-Bera statistics and p-values show that the normality assumption for all indices is rejected at all the levels of significance (1%, 5% and 10%). These statistics indicate that the indices are not normally distributed about their means and variances, thus, showing inefficiency of the market.

The descriptive statistics of the macroeconomic indicators are reported in Table 2. All the indicators are positively skewed with the exception of industrial production. The values for kurtosis reveal that the South African short-term interest rate and gold price follow a platykurtic distribution, while, inflation, industrial production and the US short-term interest rate follow a leptokurtic distribution. Similar to the sectoral indices, the results of the Jarque-Bera statistics and p-values suggest that the normality assumption is rejected at all levels of significance. Indicating that the indicators are sensitive to periodic change.

**Table 2: Descriptive statistics of selected macroeconomic indicators**

	$\pi$	$IP$	$r^f$	$r^d$	$GP$
<b>Mean</b>	0.4741	0.4690	9.1047	2.2558	792.1155
<b>Median</b>	0.4000	2.0500	8.0000	1.2500	652.9000
<b>Maximum</b>	2.3000	17.3000	21.8500	6.5000	1788.0000
<b>Minimum</b>	-0.7000	-24.1000	5.0000	0.2500	253.8000
<b>Std. Dev.</b>	0.4857	8.6275	3.7598	2.1665	481.2753
<b>Skewness</b>	0.6992	-0.9796	1.1634	0.5842	0.4649
<b>Kurtosis</b>	3.7048	3.8973	4.2436	1.7376	1.8300
<b>Jarque-Bera</b>	22.0725	41.7944	62.6240	26.6283	20.1018
<b>Probability</b>	0.0000	0.0000	0.0000	0.0000	0.0000
<b>Observations</b>	216	216	216	216	216

Note:  $\pi$ ,  $IP$ ,  $r^f$ ,  $r^d$  and  $GP$  denote "Inflation", "Industrial production", "US short-term interest rate", "SA short-term interest rate" and "Gold price" respectively.

### 4.3 Test for Stationarity

The Augmented Dickey Fuller (ADF) test is performed for each series to test for stationarity. If the null hypothesis is rejected, the ADF test is then run at 1<sup>st</sup> difference to be stationary as illustrated in Table 3.

**Table 3: Stationary Tests**

	<b>Level (t-stat; prob)</b>	<b>1<sup>st</sup> Difference</b>
<b>Resources</b>	-1.6555 (0.4525)	-8.7595 (0.0000) *
<b>Financials</b>	0.481926 (0.9858)	-14.3185 (0.0000) *
<b>Industrials</b>	-0.3281 (0.9172)	-15.0054 (0.0000) *
<b>Inflation</b>	-10.4100 (0.0000) *	-
<b>Industrial production</b>	-3.5626 (0.0074) *	-
<b>US interest rate</b>	-2.0101 (0.2824)	-4.3688 (0.0004) *
<b>SA interest rate</b>	-5.0899 (0.0000) *	-
<b>Gold Price</b>	-0.7414 (0.8327)	-17.0067 (0.0000) *

\*, \*\*, \*\*\* indicates ADF test value is significant at 1%, 5% and 10% level of significance respectively.

Table 3 reports that at 1%, 5% and 10% levels of significance; the indices, US short-term interest rate and gold price are non-stationary at level but stationary at first difference. Whereas, inflation industrial production and SA short-term interest rate are stationary at level.

#### **4.4 Regression Analysis findings**

The results of the regression analysis are displayed below in table 8, 10 and 12. The results of the individual macroeconomic indicators on the sectoral indices are interpreted below. This section also seeks to examine the consistency of the empirical findings with the theoretical expectations of the hypothesised variable relationships.

##### **4.4.1 Joint impact of the selected indicators**

It was important to check if there was no serial correlation among the residuals of the sectoral indices before performing the multiple regression analysis. Table 4, 5 and 6 show the results of the autocorrelation and partial autocorrelation function, as well as, the Ljung-Box test for the residuals of the macroeconomic indicators on the sectoral indices.

##### **4.4.2 Testing for Autocorrelation in the residuals**

The autocorrelation and partial autocorrelation coefficients of the Resources index in table 4 are not significant at all the lags. The Ljung-Box test does not reject the null hypothesis of no autocorrelation at 1% significant level for all the lags. Table 5 reports the results of the correlogram of the Financials index. It shows that only the second autocorrelation and partial autocorrelation coefficients are significant. The Ljung-Box test does not reject the null hypothesis at 1% significant level for all the lags with the exception of lag 2 and 3. Lastly, table 6 similar to the Resources index correlogram, the autocorrelation and partial autocorrelation coefficients are not

significant at all lags. Also, the Ljung-Box test does not reject the null hypothesis of no autocorrelation at 1% significant level for all the lags.

**Table 4: Autocorrelation and Partial autocorrelation for the Macroeconomic indicators on the Resources Index**

Lag	AC	PAC	Q-Stat	Prob
1	-0.0781	-0.0780	1.3267	0.2494
2	0.0932	0.0881	3.2308	0.1992
3	0.1103	0.1250	5.9075	0.1161
4	0.0084	0.0180	5.9202	0.2054
5	-0.0673	-0.0902	6.9124	0.2273
6	0.0360	0.0072	7.2030	0.3023
7	-0.0010	0.0163	7.2034	0.4083
8	-0.0410	-0.0272	7.5825	0.4753
9	0.1014	0.0942	9.9152	0.3574
10	-0.0344	-0.0200	10.1780	0.4252
11	0.0383	0.0260	10.5120	0.4851
12	0.0191	0.0070	10.5911	0.5641

**Table 5: Autocorrelation and Partial autocorrelation for the Macroeconomic indicators on the Financials Index**

Lag	AC	PAC	Q-Stat	Prob
1	-0.0494	-0.0493	0.5341	0.4654
2	-0.1672	-0.1690	6.6081	0.0372
3	0.0072	-0.0110	6.6194	0.0853
4	0.0163	-0.0120	6.6788	0.1543
5	-0.0192	-0.0202	6.7589	0.2391
6	0.1000	0.1021	8.9872	0.1742
7	-0.0390	-0.0353	9.3275	0.2302
8	0.0592	0.0931	10.1231	0.2570
9	0.0734	0.0734	11.3393	0.2534
10	-0.1162	-0.0902	14.3912	0.1560
11	-0.0033	0.0172	14.3930	0.2123
12	0.1271	0.0841	18.0790	0.1131

**Table 6: Autocorrelation and Partial autocorrelation for the Macroeconomic indicators on the Financials Index**

Lag	AC	PAC	Q-Stat	Prob
1	-0.0140	-0.0143	0.0432	0.8350
2	-0.0152	-0.0151	0.0925	0.9550
3	-0.0373	-0.0373	0.3934	0.9424
4	-0.1291	-0.1302	4.0585	0.3980
5	0.0104	0.0051	4.0816	0.5382
6	0.1202	0.1160	7.2774	0.2963
7	-0.0543	-0.0610	7.9204	0.3403

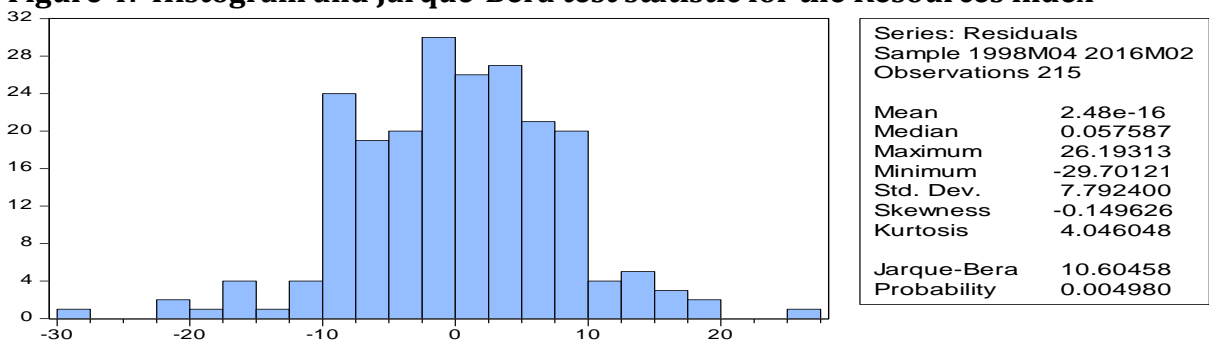


8	-0.0274	-0.0450	8.0904	0.4254
9	0.0455	0.0563	8.5412	0.4815
10	-0.0306	-0.0036	8.7467	0.5566
11	0.0217	0.0004	8.8464	0.6367
12	0.0643	0.0488	9.7842	0.6353

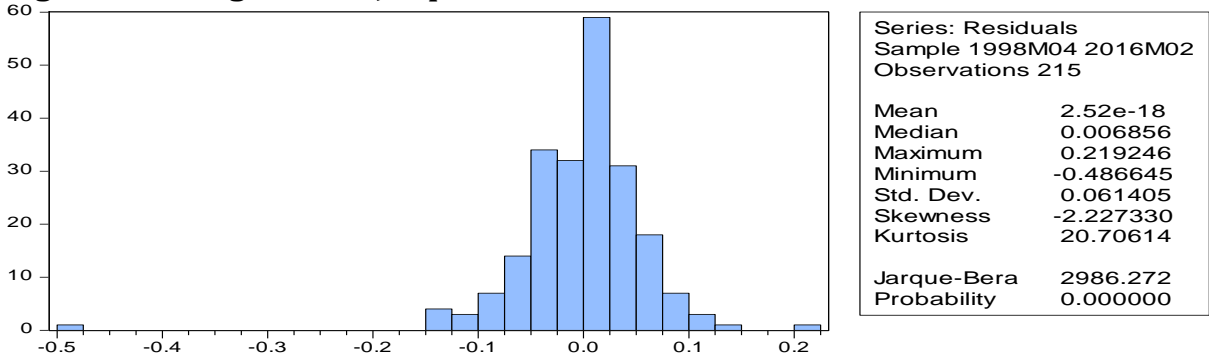
#### 4.4.3 Normality Test

Using the Jarque-Bera test statistic the residuals for all the sectoral indices were tested to assess if they follow a normal distribution, the results are displayed in figure 4, 5 and 6 below. The results of the test show that for the Resources index the p-value is less than the 5% significant level thus, the null hypothesis that the residuals are normally distributed is rejected. For the Financials index, the normality assumption is rejected at the 5% significant level. Lastly, the p-value of the Jarque-Bera test for the Industrials index is less than the 5% significant level thus, the normality assumption is also rejected.

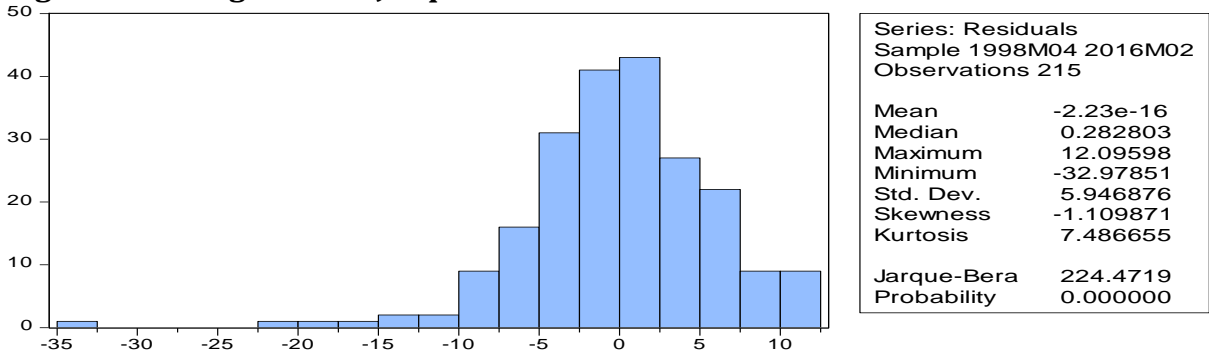
**Figure 4: Histogram and Jarque-Bera test statistic for the Resources index**



**Figure 5: Histogram and Jarque-Bera test statistic for the Financials index**



**Figure 6: Histogram and Jarque-Bera test statistic for the Industrials index**



#### 4.4.4 Testing for Heteroscedasticity and Serial correlation in the residuals

White's test for heteroscedasticity was used to test for linear form of heteroscedasticity. The results are displayed in table 7. The Chi-square p-value of the White test for all the sectoral indices is greater than the 5% significant level, thus the residuals are homoscedastic.

The Breusch-Godfrey serial correlation LM test was used to test for serial correlation and 12 lags (for monthly data) were selected, the results are displayed in table 10.

**Table 7: Heteroscedasticity Test – White and the Breusch-Godfrey serial correlation LM test**

<b>Heteroscedasticity Test</b>			
<b>Resources index</b>			
F-statistic	0.6703	Prob. F(20,194)	0.8523
Obs*R-squared	13.8965	Prob. Chi-Square(20)	0.8357
<b>Financials index</b>			
F-statistic	0.5342	Prob. F(20,194)	0.9494
Obs*R-squared	11.2223	Prob. Chi-Square(20)	0.9403
<b>Industrials index</b>			
F-statistic	1.4108	Prob. F(20,194)	0.1207
Obs*R-squared	27.2998	Prob. Chi-Square(20)	0.1270
<b>Breusch-Godfrey serial correlation LM test</b>			
<b>Resources index</b>			
F-statistic	0.8720	Prob. F(12,197)	0.5764
Obs*R-squared	10.8442	Prob. Chi Square(12)	0.5423
<b>Financials Index</b>			
F-statistic	1.3025	Prob. F(12,197)	0.2193
Obs*R-squared	15.8052	Prob. Chi-Square(12)	0.2003
<b>Industrials Index</b>			
F-statistic	0.7712	Prob. F(12,197)	0.6795
Obs*R-squared	9.6479	Prob. Chi-Square(12)	0.6468

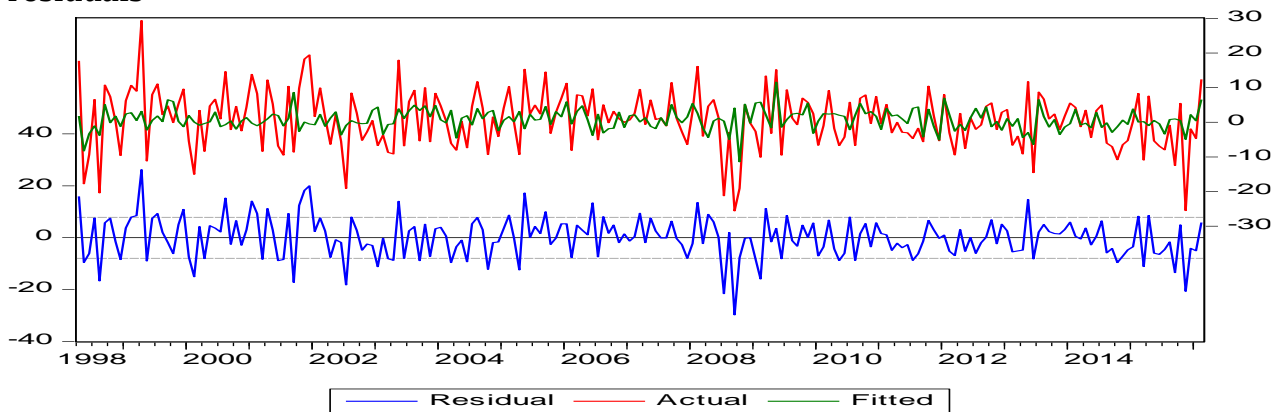
The results for the Resources index residuals conclude that the null hypothesis of no serial autocorrelation should not be rejected since the p-value (0.5423) of the Observed R square value is greater than the 5% significant level. Figure 7 shows the graph of the actual, fitted and residuals which further confirms that there is no serial autocorrelation in the residuals.

The graph in figure 7 depicting the Resources index regression residuals shows that there are a number of outliers present with the largest occurring in April 1999 and September 2008. The positive outlier in April 1999 could have been caused by the announcement made by President Nelson Mandela that the second democratic elections would take place in June 1999.

The spike in September 2008 was caused by: reports that inflation had reached a record high for a third consecutive month; the depreciating rand as a result of

reduced appetite towards South African commodities and slow manufacturing output due to high interest rates which has reduced consumer spending.

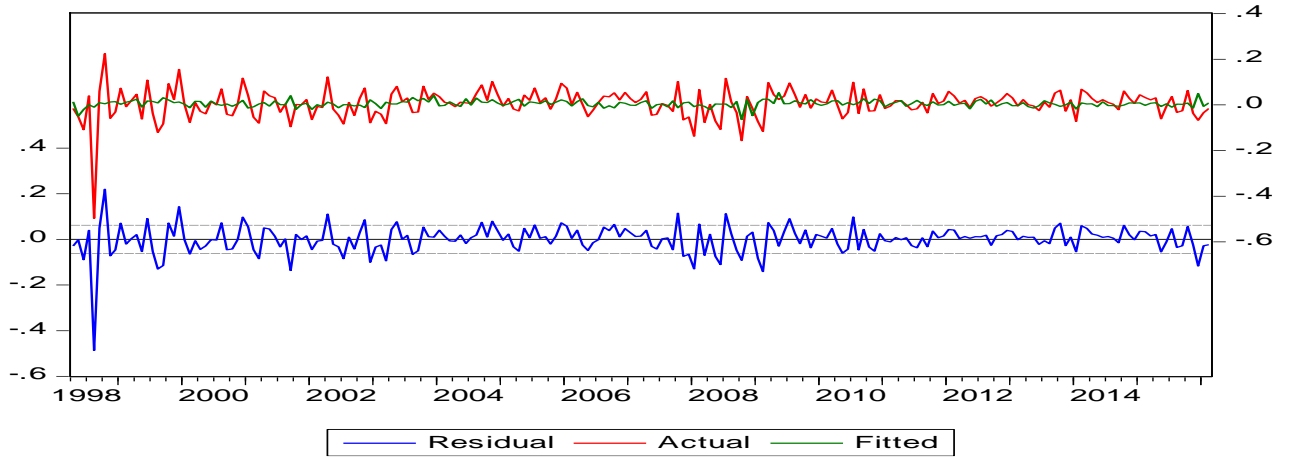
**Figure 7: The actual, fitted and residuals graph for the Resources Index residuals**



The results of the Financials index residuals conclude that the null hypothesis of no serial autocorrelation should not be rejected since the p-value (0.1928) of the Observed R square is greater than the 5% significant level. Figure 8 shows the graph of the actual, fitted and residuals which further confirms that there is no serial autocorrelation in the residuals.

The graph in figure 8 depicting the Financials index regression residuals shows that there are two (2) major outliers present occurring in August 1998 and October 1998. The banking crisis that hit the Asian economies caused a global slowdown in trade and investments in emerging markets. “During this slowdown the South African rand depreciated and the JSE All-share index lost a third of its value during this period” (1998 Medium Term Budget Policy Statement).

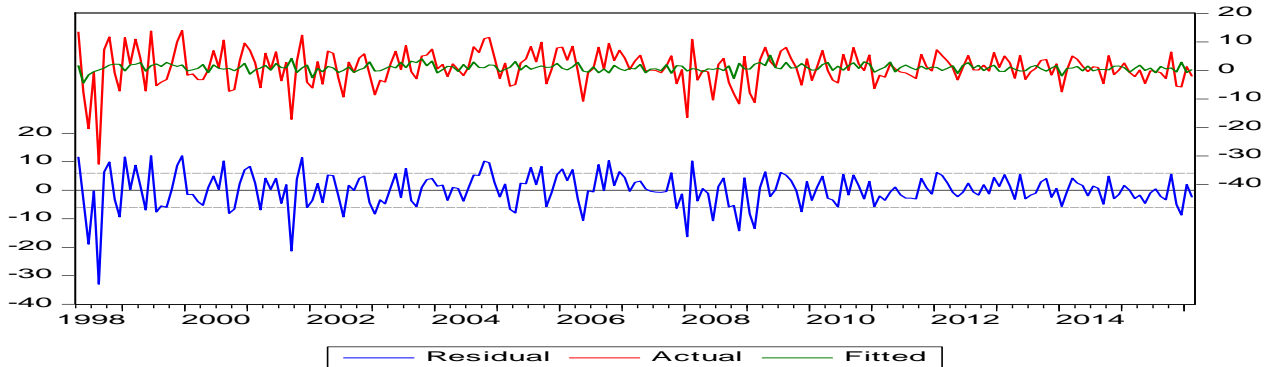
**Figure 8: The actual, fitted and residuals graph for the Financials Index residuals**



Lastly, the results for the residuals of the Industrials index conclude that the null hypothesis of no autocorrelation should not be rejected since the p-value (0.6110) of the Observed R square is greater than the 5% significant level. This test shows that there is no evidence of serial correlation among the residuals of the sectoral indices. Figure 9 shows the graph of the actual, fitted and residuals which further confirms that there is no serial autocorrelation in the residuals.

The graph in figure 9 depicting the Industrials index regression residuals shows that the biggest outlier occurs in August 1998, while the other large outliers seem to be close in value, it appears that the outlier occurring in June 1998 is the most significant since it improves the normality of the regression. The Industrials index seems to be affected by the Asian banking crisis which also affected the Financials index.

**Figure 9: The actual, fitted and residuals graph for the Industrials Index residuals**



The study then proceeds to test the regression analysis to ascertain the impact of the macroeconomic indicators on the sectoral indices.

#### **4.4.5 Multiple Regression Analysis**

The multiple regression for the Resources index in table 8, reports that both the R-squared and adjusted R-squared have low values and the F-statistic has a p-value of zero which shows that the null hypothesis tested which is, all of the slope parameters are jointly zero, should be rejected at the 5% significant level. The low R-squared (0.123573) and adjusted R-squared (0.102606) values suggest that there are other significant macroeconomic indicators which are not included in the model, as this study only uses five (5) macroeconomic indicators.

However, some of the independent variables are not significantly different from zero, that is; inflation, industrial production and the US short-term interest rate. To further assess if these variables are insignificant, an F-test, displayed in table 10, was used to test the null hypothesis that the variables are jointly zero. The F-statistic is 0.595276 and the p-value is 0.6188 which suggests that the null hypothesis is not rejected. The remaining variables that is; SA short-term interest rate and gold price are significant at the 5% significant level therefore they are not included in the F-test and thus retained.

**Table 8: Multiple regression of macroeconomic indicators on the Resources index.**

Variable	Coefficient	t-Statistic	Prob.
C	0.3597	0.6586	0.5108
DCPI	1.4976	1.0640	0.2886
DINDUSTRIAL_PRODUCTION	0.0242	0.5674	0.5710
DSA_INTEREST_RATE	-31.3762	-2.3922	0.0176
DUS_INTEREST_RATE	2.0491	0.4945	0.6214
DGOLDPRICE	0.4721	4.3109	0.0000
R-squared	0.1236		
Adjusted R-squared	0.1026		
F-statistic	5.8936		
Prob(F-statistic)	0.0000		

**Table 9: Resources index F-test.**

Wald Test			
Test Statistic	Value	Df	Probability
F-statistic	0.5952	(3, 209)	0.6188
Chi-square	1.7858	3	0.6180
Null Hypothesis: C(2)=0, C(3)=0, C(5)=0			
Normalized Restriction (=0)		Value	Std. Err.
C(2)		1.4977	1.4076
C(3)		0.0243	0.0428
C(5)		2.0491	4.1434

For the Financials index the multiple regression reports that both the R-squared (0.0517) and adjusted R-squared (0.0290) have low values and the F-statistic has a p-value of 0.0479 suggests that we reject the null hypothesis at the 5% significant level. The results for the multiple regression are displayed in table 10.

In this case only inflation, industrial production and gold price are not significantly different from zero. The results of the F-test in table 11 report the F-statistic to be 1.4854 and the p-value is 0.2196, thus, the null hypothesis is not rejected. Since the other variables, that is; the SA short term interest rate and the US short term

interest rate are significant at the 1% level they are retained and therefore not included in the F-test.

**Table 10: Multiple regression of macroeconomic indicators on the Financials index.**

Variable	Coefficient	t-Statistic	Prob.
C	0.0042	0.9836	0.3264
DCPI	0.0100	0.9072	0.3653
DINDUSTRIAL_PRODUCTION	-0.0004	-1.3928	0.1651
DSA_INTEREST_RATE	-0.2136	-2.0671	0.0400
DUS_INTEREST_RATE	0.0513	1.5723	0.1174
DGOLDPRICE	0.0012	1.4339	0.1531
R-squared	0.0517		
Adjusted R-squared	0.0290		
F-statistic	2.2807		
Prob(F-statistic)	0.0478		

**Table 11: Financials index F-test.**

Wald Test			
Test Statistic	Value	df	Probability
F-statistic	1.4853	(3, 209)	0.2196
Chi-square	4.4561	3	0.2162
Null Hypothesis: C(2)=0, C(3)=0, C(6)=0			
Normalized Restriction (=0)		value	Std. Err.
C(2)		0.0100	0.0110
C(3)		-0.0004	0.0003
C(6)		0.0012	0.0008

Table 12 reports the results for the Industrials index reports that both the R-squared (0.0425) and adjusted R-squared (0.0196) have low values and the F-statistic has a value of 1.8590 with a p-value greater than the 1% significant level which suggests that we fail to reject the null hypothesis, which means that all the macroeconomic indicators are not significant.



**Table 12: Multiple regression of macroeconomic indicators on the Industrials index.**

Variable	Coefficient	t-Statistic	Prob.
C	0.8172	1.9607	0.0512
DCPI	-0.0983	-0.0915	0.9271
DINDUSTRIAL_PRODUCTION	-0.0563	-1.7262	0.0858
DSA_INTEREST_RATE	-21.0904	-2.1070	0.0363
DUS_INTEREST_RATE	1.8130	0.5733	0.5670
DGOLDPRICE	0.0952	1.1402	0.2555
R-squared	0.0425		
Adjusted R-squared	0.0196		
S.E. of regression	6.0175		
Sum squared resid	7568.1810		
Log likelihood	-687.8868		
F-statistic	1.8590		
Prob(F-statistic)	0.1028		

#### 4.5 Summary of regression findings

Inflation was found to have a positive effect on the Resources and Financials indices. Whereas, for the Industrials index, inflation was found to have a negative impact. These findings are supported by the research conducted for the Indian stock market by Ray et al. (2003) and Adaramola (2011), respectively. Ray et al. (2003) found that an increase in inflation leads to an increase in the stock returns since investors look to the stock market for decent returns.

This positive relationship of inflation with the Resources and Financial sector returns disagrees with the earlier expectation that when inflation increases households and corporates tend to save more affecting the level of spending. It is possible that firms classified under the Resources and Financials indices transfer the cost of inflation to their products, thus, an increase in inflation results in an increase in profits such that the sector delivers above average returns.

The negative relationship of inflation with the Industrials sector returns is consistent with earlier expectation but not with the findings of the other sectoral

indices. As inflation decreases the input costs for the firms in the industrial sector decreases which improves the profit margin of those firms and thus the sector performance. However, it must be noted that the variable was found to be insignificant in explaining the variation of all the indices. Further, the variable was restricted in the multiple regressions after the F-test was performed. Adaramola (2011) also found inflation to have an insignificant effect on the stock market returns.

Industrial production had a positive effect on the Resources index, while, its impact on the Financials and Industrials indices was found to be negative. This result is supported by Naka et al. (1998), Humpe and Macmillan (2007) and Naik and Padhi (2012) who also found a positive relation with industrial production in India. The study by Ibrahim et al. (2014) supports the findings of a negative relation of the stock market returns and industrial production.

Naik and Padhi (2012) suggest that an increase in industrial production leads to an increase in the profit margins of corporates which then increases the stock price. Naka et al. (1998) found that a positive effect of industrial production leads to a 10% stock market increase over the period of their study.

Positive movements of industrial production stimulate consumer spending since the economy is showing signs of positive growth. It also has a positive effect on the firms in the Resources index since it affects expected future cash flows.

The negative relation of industrial production with the Financials index could possibly arise as a result of a good performing financial industry. As economic growth slows the demand for products in Industrial sector should decrease this could mean the domestic industrial sector is influenced by external factors as opposed to domestic factors. Hence, the negative relation of industrial production with the Industrials index.

Similar to inflation, industrial production was found to be an insignificant variable, it was also restricted in the multiple regressions after the F-test was performed. In the study conducted by Miseman et al. (2013) they also found that industrial production had an insignificant impact on stock returns of five ASEAN (Malaysia, Indonesia, Thailand, Singapore and Philippines) stock returns.

The SA short-term interest rate was found to have a negative and significant effect on both the Resources and Financials indices. It had a negative effect on the Industrials index, although, it was found to be an insignificant variable in the model. The negative relation with the indices is supported by Addo and Sunzuoye (2011) who also found that interest rate is not significant in Ghana.

The negative relation of the SA short-term interest rate with the indices is aligned with the earlier expectation. Short-term interest bearing securities are usually used by firms for liquidity exposure, as such, a decline in the short-term interest rate will result in investors shifting to listed equity which increases the performance of the sectors.

The US short-term interest rate had a positive effect on all the indices. However, it was only significant on the Financials index, while it was found to be insignificant on the Resources and Industrials indices. The results of the F-test show that the variable was restricted in both the multiple regressions and not retained in the models. The research conducted by Garza-Garcia and Vera-Juarez (2010) supports this finding for Brazil and Chile.

The positive relationship between the variable and the returns of all the indices contradicts the theoretical assumption. It is expected that an interest rate hike in the US will see a capital outflow from the JSE as investors chase a higher yield in the US.

It is possible that the interest rate movements were marginal and did not influence investors.

The gold price had a positive effect on all the indices. The study conducted by Mamipour et al. (2015) and Kothari et al. (2015) agree with this result, they also found a positive relationship between the gold price and the stock returns in Iran and India, respectively. It must be noted that gold price was found to be significant on only the Resources index.

Gold price has a positive influence on the returns of the indices which is in line with the theoretical expectations. This could be a result of the increased domestic inflation and the market volatility in foreign markets during this period. Since gold has been used to hedge against market decline, the positive relationship could signal market decline.

#### **4.5.1 Sensitivity of the sectoral indices to the US and SA interest rates.**

The results suggest that all the sectoral indices are more sensitive to the SA short-term interest rate. While the US short-term interest rate is a significant variable for only the Financials index. The marginal movements of the US short-term interest rate during this period could have been the reason why the US short-term interest rate was not influential. The SA short-term interest rate was more influential as a result of the South African Reserve Bank increasing rates in order to control the inflation rate when it went beyond the target band. Also, when rates are decreased to stimulate economic growth. These results are echoed by Sahu (2015) who found that in India investors' investment decisions should be influenced by the domestic variables since they have a bigger impact on the stock market than the foreign variables.

## **4.6 Granger-causality**

This section presents the findings of the Granger causality analysis performed in this study. Five (5) pairs of macroeconomic indicators were analysed for each sectoral index as displayed below in table 13, 14 and 15. The unit root test above shows that some of the variables become stationary after transforming them into their first differences. The Breusch-Godfrey serial correlation LM test above shows that there is no serial correlation.

The Granger causality test between the Resources index and each of the macroeconomic indicators is presented below in table 13. The results show that there only exists a uni-directional causal relationship between the Resources index and the US short-term interest rate. The findings are supported by Xiufang Wang (2010) who also found a unidirectional causal relationship from the stock returns to the interest rate. The results in table 13 also found that no causality exists between the Resources index and any of the other macroeconomic indicators. Ali et al. (2010) also found that there was no causality between Industrial production and inflation with the stock returns. Narang et al. (2012) found no causal relationship between gold price and stock market returns in India.

**Table 13: Granger causality test**

Hypothesis	Obs.	F-statistics	P-value	Decision	Type of Causality
$\pi$ does not Granger Cause SPR	203	0.8473	0.6017	DNR	No causality
SPR does not Granger Cause $\pi$	203	1.2404	0.2587	DNR	No causality
IP does not Granger Cause SPR	203	0.7264	0.7244	DNR	No causality
SPR does not Granger Cause IP	203	1.4234	0.1588	DNR	No causality
$r^d$ does not Granger Cause SPR	203	0.9698	0.4795	DNR	No causality
SPR does not Granger Cause $r^d$	203	1.4145	0.1628	DNR	No causality
$r^f$ does not Granger Cause SPR	203	0.9232	0.5250	DNR	No causality
SPR does not Granger Cause $r^f$	203	1.8223	0.0476**	Reject	Uni-directional causality
GP does not Granger Cause SPR	203	0.6526	0.7946	DNR	No causality
SPR does not Granger Cause GP	203	0.4060	0.9600	DNR	No causality

*\*, \*\*, \*\*\* indicates significant values at 1%, 5% and 10% level of significance respectively.*

*Note: SPR, SPF, SPI,  $\pi$ , IP,  $r^f$ ,  $r^d$ , GP and DNR denote "FTSE/JSE Resources 20", "FTSE/JSE Financials" and "FTSE/JSE Industrials" "Inflation", "Industrial production", "US short term interest rate", "SA short term interest rate", "Gold price" and "Do not Reject" respectively.*

The Granger causality test between the Financials index and each of the macroeconomic indicators is presented below in table 14. The results show that there exists a uni-directional causal relationship between: the Financials index and the SA short-term interest rate, the Resources index and the US short term interest rate. Garza-Garcia and Vera-Juarez (2010) and Barbic and Condic-Jurkic (2011) also found that the stock returns lead the interest rate. The results in table 14 also show that there is no causal relationship between the Financials index and any of the remaining macroeconomic indicators. Ray (2012) also found that there is no causality between the stock returns and industrial production. Ali et al. (2010) found

no causality between stock returns and inflation. Narang et al. (2012) also found no causal relationship between gold price and stock market returns in India.

**Table 14: Granger causality test**

Hypothesis	Obs.	F-statistics	P-value	Decision	Type of Causality
$\pi$ does not Granger Cause SPF	203	0.4450	0.9429	DNR	No causality
SPF does not Granger Cause $\pi$	203	1.0143	0.4376	DNR	No causality
IP does not Granger Cause SPF	203	1.1859	0.2962	DNR	No causality
SPF does not Granger Cause IP	203	0.9313	0.5169	DNR	No causality
$r^d$ does not Granger Cause SPF	203	0.8434	0.6057	DNR	No causality
SPF does not Granger Cause $r^d$	203	1.4771	0.1364***	Reject	Uni-directional causality
$r^f$ does not Granger Cause SPF	203	1.3755	0.1813	DNR	No causality
SPF does not Granger Cause $r^f$	203	3.1752	0.0004*	Reject	Uni-directional causality
GP does not Granger Cause SPF	203	1.1137	0.3515	DNR	No causality
SPF does not Granger Cause GP	203	0.5840	0.8533	DNR	No causality

*\*, \*\*, \*\*\* indicates significant values at 1%, 5% and 10% level of significance respectively.*

*Note: SPR, SPF, SPI,  $\pi$ , IP,  $r^f$ ,  $r^d$ , GP and DNR denote "FTSE/JSE Resources 20", "FTSE/JSE Financials" and "FTSE/JSE Industrials" "Inflation", "Industrial production", "US short term interest rate", "SA short term interest rate", "Gold price" and "Do not Reject" respectively.*

The Granger causality test between the Industrials index and each of the macroeconomic indicators is presented below in table 15. The results reveal that there exists a uni-directional causal relationship between: the Industrials index and the inflation, industrial production and the Industrial index; the Financials index and the SA interest rate; the Industrials index and the US interest rate. The studies by Tripathy (2011), Xiufang Wang (2010) and Forson and Janrattanagal (2013) found that the stock returns lead inflation, industrial production leads the stock returns

and the stock returns lead the interest rate, respectively. Narang et al. (2012) also found no causal relationship between gold price and stock market returns in India.

**Table 15: Granger causality test**

Hypothesis	Obs.	F-statistics	P-value	Decision	Type of Causality
$\pi$ does not Granger Cause SPI	203	0.6673	0.7811	DNR	No causality
SPI does not Granger Cause $\pi$	203	1.8884	0.0384**	Reject	Uni-direction causality
IP does not Granger Cause SPI	203	2.4784	0.0051*	Reject	Uni-direction causality
SPI does not Granger Cause IP	203	0.9946	0.4559	DNR	No causality
$r^d$ does not Granger Cause SPI	203	1.1078	0.3563	DNR	No causality
SPI does not Granger Cause $r^d$	203	1.9983	0.0267**	Reject	Uni-direction causality
$r^f$ does not Granger Cause SPI	203	1.3391	0.2000	DNR	No causality
SPI does not Granger Cause $r^f$	203	2.5809	0.0035*	Reject	Uni-direction causality
GP does not Granger Cause SPI	203	0.6555	0.7920	DNR	No causality
SPI does not Granger Cause GP	203	0.5901	0.8484	DNR	No causality

*\*, \*\*, \*\*\* indicates significant values at 1%, 5% and 10% level of significance respectively.*

*Note: SPR, SPF, SPI,  $\pi$ , IP,  $r^f$ ,  $r^d$ , GP and DNR denote "FTSE/JSE Resources 20", "FTSE/JSE Financials" and "FTSE/JSE Industrials" "Inflation", "Industrial production", "US short term interest rate", "SA short term interest rate", "Gold price" and "Do not Reject" respectively.*

Given the results displayed above, it can be concluded that the selected macroeconomic indicators do not have a relevant Granger causal relationship with any of the sectoral indices, with the exception of industrial production and the Industrials index. However, all the macroeconomic indicators are found to be insignificant variables for Industrials multiple regression model. This suggests that the sectoral indices have been an influencing factor of the macroeconomic



indicators and that macroeconomic indicators have not been valuable predictive factors for future returns of the sectoral indices.

This chapter presented the results of the econometric tests used in this paper. There was evidence to suggest that the JSE sectoral indices lead the macroeconomic indicators showing the existence of causality which is in line with the literature reviewed and the theoretical expectation. It was also found that some macroeconomic indicators are not significant in explaining the variation of the sectoral indices. There was no evidence of influential causal direction from the macroeconomic indicators to the sectoral indices, with the exception of industrial production on the Industrials index. The final chapter provides concluding remarks and recommendations for further studies on this topic.

## **Chapter Five**

### **Conclusion and Policy Implications**

This chapter summarizes the main findings of the study. It will use the results to answer the research questions posed in chapter one and also assess the hypothesised variable relationships. After summarising the findings of the study we then discuss the limitations of the study and recommendations on further studies.

#### **5.1 Conclusion**

The aim of this study is to ascertain if there is a relationship between macroeconomic indicators (inflation, industrial production, SA short-term interest rate, US short-term interest rate and gold price) and the JSE sectoral indices (Resources, Financials and Industrials). Using a multiple regression analysis and the Granger causality test, this study examines the impact of macroeconomic indicators on the JSE sectoral indices and the causal direction of the relationship.

The Granger causality test shows that there is: a uni-directional causal relationship from the Resources index to the US short-term interest rate; a uni-directional causal relationship from the Financials index to the SA short-term interest rate and the US short-term interest rate; and a uni-directional causal relationship between the Industrials index and inflation, Industrials index and US short-term interest rate, Industrials index and SA short-term interest rate, industrial production and the Industrials index. The results also show that there is no causal relationship between the indices and the other macroeconomic indicators, which is not in line with the stated variable hypothesis.

Further, the study found a positive and insignificant relationship between the Resources index and inflation, industrial production, the US short-term interest rate and gold price. While the SA short term interest rate has a negative and significant

relationship with the Resources index, which is in line with the earlier expectation. Further, the inflation, industrial production and the US short-term interest rate were restricted in the multiple regression after the F-test was performed. Thus, only the SA short-term interest rate and gold price jointly impact the Resources index, negatively and positively, respectively.

There was a positive relation found between the Financials index and inflation and gold price. Also a negative relation was found between the Financials index and industrial production, however, all of these variables were found to be insignificant in explaining the variation of the Financials index. The positive inflation, negative industrial production and positive US short term interest rate disagrees with the earlier expectations. Further, the inflation, industrial production and gold price were restricted in the multiple regression after the F-test was performed. Thus, only the SA short-term interest rate and US short-term interest rate jointly impact the Financials index, negatively and positively, respectively.

Lastly, the Industrials index was found to be negatively impacted by inflation, industrial production and SA short-term interest rate. Whereas, the US short term interest rate and gold price positively impact the index. However, it must be noted that all the variables are found to insignificant in explaining the variation of the Industrials index.

Contrary to theoretical expectations, the selected macroeconomic indicators appear to lack predictive information. While the SA short-term interest rate is the only variable that is significant for all the indices. Also, the results suggest that all the sectoral indices are more sensitive to the SA short-term interest rate than the US short-term interest rate.

The SA short-term interest rate appears to be the most significant variable among the selected macroeconomic indicators. Thus, when policy-makers are attempting to stimulate the economy, the influence of the SA short-term interest rate on the JSE

sectoral indices must be considered. As such, this study is useful to market participants and the literature.

## **5.2. Policy implications**

In this study it was found that a relationship between macroeconomic indicators and sectoral indices exists. The literature suggests that active stock markets have a positive influence on the development of the economy by creating liquidity and generating wealth for investors.

The macroeconomic indicators used in the study, namely; inflation, industrial production, SA short-term interest rate, US short-term interest rate and gold price have a significant influence on long-term economic growth, reallocation of capital and socioeconomic development. Thus, given the above, policy makers in South Africa should aim to control these indicators, in order to maintain a liquid stock market, particularly the SA short-term interest which was found to be the most significant variable for all the indices. The negative relation found for all indices with the SA short-term interest rate implies that policy makers should keep rates low to boost economic development.

A wide variety of factors influence retail and institutional investors' investment decisions, according to this study this should also include macroeconomic indicators based on the impact they have on the sectoral indices. This is especially true with the SA short-term interest rate. Which must be used to guide their investment policies.

The study also found that macroeconomic indicators have a differing impact on the sectoral indices. As such, participants in the Resources sector must consider declining SA short-term interest rates and increasing gold price when making business strategies and investment guidelines. While participants in the Financial sector the results suggest that declining SA short-term interest rate and increasing

US short-term interest rate must be considered when making business decisions. Lastly, for the Industrials sector declining industrial production and SA short-term interest rate should guide business strategies for participants in this sector.

Further, the results of the study suggest that in the South African context the SA short-term interest rate is found to be a significant variable across all the indices. Thus, for academic purposes it must be noted that the variable has an impact on the South African stock market as a whole.

### **5.3 Further studies**

This study presents a good reference for further research of the analysis conducted above. First, for a broader perspective a similar study can be conducted using the JSE All-share and sectoral indices. Secondly, it is necessary to perform the study with two samples each for a period of economic growth and economic decline. Other macroeconomic indicators could be used to conduct the study which may lead to different outcomes offering new information. The use of foreign macroeconomic indicators could be used to compare their impact with domestic macroeconomic indicators. Finally, using a different model, such as, the Johansen co-integration test and GARCH model to measure the short and long run effect and also the volatility effect of the macroeconomic indicators on the stock returns could be used to extend to this study.

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