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Do Macroeconomic Variables Explain Future Stock Market Movements in South Africa?

A Research Report

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University of Cape Town

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the requirements for the*

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by

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Do macroeconomic variables explain future stock market movements in South Africa?

Abstract

This study aims to address the empirical question of whether macroeconomic variables drive future stock market returns in South Africa. If found, the macroeconomic variables would therefore constitute useful predictive information for the future FTSE/JSE All Share Index. The data was examined from 1965 to 2010 which constitutes the longest study of its nature in South Africa. The macroeconomic variables were selected based on international and local precedent of intuitive influential macroeconomic factors. Through the use of Johansen multivariate cointegration, Granger causality and innovation accounting, it was found that the selected South African macroeconomic variables did not significantly influence future FTSE/JSE All Share Index returns. Therefore the chosen macroeconomic variables should not be used as a future predictive tool for South African stock market returns.

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Do macroeconomic variables explain long term stock market movements in South Africa?

1. Introduction

Equity prices are generally expected to have a strong relationship with macroeconomic variables. Economic factors affect the discount rates, companies' ability to generate cash flows as well as future dividend payouts. Thus, the macroeconomic variables may become a key driver of underlying company returns. These returns should then influence the intrinsic stock price of the share and therefore an observable relationship should be expected and subsequent causality should be found.

Previous studies, both internationally and locally have looked to examine the relationship and causality between macroeconomic variables and stock market returns in order to ascertain whether current and future stock market returns are a function of past macroeconomic variables. If macroeconomic variables do constitute predictive information for future stock market returns, it would be critical to take macroeconomic variables into account when making investing decisions.

Johansen cointegration (Johansen 1991) and Granger causality analysis (Granger 1969) is used in this study and is an approach that has become standard empirical tests when investigating long run relationships and the subsequent underlying causality. Innovation accounting is then used as an additional evaluation method in order to analyse the interrelationships amongst the variables chosen. This is done through examining the response of the stock exchange to a significant movement in the selected macroeconomic variables.

This paper uses this above prescribed approach in order to examine whether South African macroeconomic factors influence the Johannesburg Stock Exchange returns (FTSE/JSE All Share Index) for 45 years from 1965 to 2010 and therefore whether they compose future predictive information for JSE returns.

According to Zhou (2001), defining long run relationships and subsequent interpretations from cointegration depend on both of the length of time of the study as well as the number of observations. Zhou (2001) found that using an insufficient number of observations, a short timeline – which depends on the frequency of these observations, and a high lag length between data points, may yield inaccurate results.

This study avoids these potential issues by using a significantly long time horizon with a high number of observations and a short lag length between observations when testing the data and the subsequent findings of predictive ability of the variables on the stock exchange.

This paper is structured in the following way: section 2 is a literature review of previous studies analysing the role macroeconomic factors have in stock market returns both internationally and locally. Section 3 delves into the hypothesised model and the theoretical expected outcomes of the model. Section 4 briefly states the data period and resource used to acquire the data. The empirical methodology is outlined in section 5. Section 6 deals with the empirical results of the relationship through cointegration, causal analysis and innovation accounting. Following these results, section 7 hypothesises subsequent plausible explanations for the empirical results. Finally, section 8 offers the conclusion of the study and section 9 proposes possible avenues for further analysis.

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2. Literature Review

2.1 A Brief Background

The relationship between the macroeconomic variables and stock market returns has been derived primarily through two different methodologies. Historically, the arbitrage pricing theory (APT) (Ross, 1976) has been used as the methodology to explore the link where multiple risk factors can explain asset returns. Early empirical papers on APT focussed on individual security returns but it may also be used for the stock market, where a change in a macroeconomic variable could be seen as a change in the underlying systematic risk factor influencing future returns.

Relevant studies that have used this include Fama (1981, 1990), Chen et al. (1986), Fama and French (1989), Schwert (1990), Ferson and Harvey (1991) and Black, Fraser and MacDonald (1997). These studies generally model a short run relationship between macroeconomic variables and stock price returns. Each of these studies have found that stock returns and various macroeconomic factors are, to varying degrees, correlated, using either developed or developing countries' market data.

An alternative approach that is widely used is cointegration analysis which was initially proposed by Granger (1986) and subsequently enhanced by Johansen (1991) and is a well established methodology when testing long run relationships among variables. A finding of cointegration amongst the variables over an extended period of time implies the existence of a long run relationship as they share a common trend. If it exists, one is able to determine the relationship amongst these variables by using a vector error correction model (VECM).

From the cointegration and VECM, the Granger causality test which was first formulated by Granger (1969), is used to interpret whether one factor may be influential in another factor's future value. For example, if lagged values of X help to predict current values of Y then X is said to Granger cause Y . Granger causality is widely used in these types of studies to find whether the values of stock indexes are functions of past and current values of macroeconomic variables. Innovation accounting is then used to demonstrate the effect of a unit shock or movement of a macroeconomic variable on the stock market and aides in the support of the findings of the Granger causality.

A significant number of previous international studies have applied cointegration, causality and innovation accounting in their analysis in establishing long run relationships between stock prices

and macroeconomic variables across various developed and developing countries including, to a limited extent, South Africa¹.

2.2 International Literature

Mukherjee and Naka (1995) looked at the Japanese stock market and found that the relationship with the Japanese Yen / U.S. dollar exchange rate, the Industrial Production Index and money supply is positive and the relationship with inflation (CPI) and long term government bond rate is negative, however, the causality between the Japanese stock market and the macroeconomic variables was not examined.

Cheung and Ng (1998) examined Canada, Germany, Italy, Japan and the U.S. and found that there was long run evidence of country specific economic variables. Real oil price, real output, real money supply and real consumption were found to have a significant relationship with the stock markets. Real oil price was found to have a negative relationship and real output a positive relationship whilst both real money supply and real gross national product (GNP) on the stock markets were ambiguous and the causality was not examined.

Kwon and Shin (1999) investigated whether current economic activities in South Korea can explain stock market returns by using a cointegration test from a vector error correction model and the subsequent causality using the Granger causality test. The study finds that the Korean stock market reflects macroeconomic variables on stock price indices. The cointegration test and the vector error correction model illustrate that stock price indices are cointegrated with a set of macroeconomic variables—that is, the production index, exchange rate, trade balance, and money supply—which

¹ International papers who used cointegration include Mukherjee and Naka (1995), Cheung and Ng (1998), Kwon and Shin (1999), Maysami and Koh (2000), Nasseh and Strauss (2000), McMillan (2001), Wongbangpo and Sharma (2001), Ibrahim and Aziz (2003), Karamustafa and Kucukkale (2003), Gunsekaraage et al. (2004), Chaudhuri and Smiles (2004), Gan et al. (2006) and Humpe and MacMillan (2009). South African studies that have used this cointegration include Odhiambo (2011), Alagidede and Panagiotidis (2010), Bonga-Bonga and Makakbule (2010), Moolman (2004), Jefferis and Okeahalam (2000). The Granger causality test used to investigate the underlying driver of the relationships was applied by Kwon and Shin (1999), Nasseh and Strauss (2000), Wongbangpo and Sharma (2001), Ibrahim and Aziz (2003), Karamustafa and Kucukkale (2003), Gunsekaraage et al. (2004), Gan et al. (2006), Wong, Khan and Du (2006) and Brahma-srene and Jiranyakul (2007) with Odhiambo (2011) and Van Rensburg (1998) using causality analysis on South African data. With regard to innovation accounting decomposition, Gan et al. (2006), Wongbangpo and Sharma (2001), Ibrahim and Aziz (2003) were among the others to use this analysis in order to assess their study specific variable's influence on the stock market.

provides a direct long run equilibrium relation with each stock price index. The stock price variability was found to be fundamentally linked to economic variables and the change in stock price lags behind those economic activities.

Maysami and Koh (2000) researched the long term equilibrium relationships between the Singapore stock index and selected macroeconomic variables. They found that changes in Singapore's stock market levels do form a cointegrating relationship with changes in price levels, money supply, short and long term interest rates and exchange rates. While changes in interest and exchange rates contribute significantly to the cointegrating relationship, those in price levels and money supply do not. There were negative relationships with interest rate and price levels (inflation) and positive relationships with exchange rate and money supply, although inflation and money supply factors were not significant to the Singapore stock market. The causality between the variables and the Singapore stock exchange was not investigated.

Nasseh and Strauss (2000) found a significant long relationship between stock prices and domestic and international economic activity in France, Germany, Italy, Netherlands, Switzerland and the United Kingdom (U.K). In particular, they find large positive coefficients for industrial production and the consumer price index, and smaller but nevertheless positive coefficients on short term interest rates and business surveys of manufacturing. The only negative coefficients are found on long term interest rates. They also found support for macroeconomic variables having strong explanatory power in contributing to the forecast variance of stock prices.

Wongbangpo and Sharma (2001) raised the empirical question regarding the fundamental connection between stock prices and key macroeconomic variables of five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore and Thailand). Using GNP, the consumer price index, the money supply, the interest rate and the exchange rate they observed both long and short term relationships between the stock prices and these macroeconomic variables. The results were consistent for the five countries with a positive relationship with GNP and a negative relationship with CPI. The relationships between stock prices and money supply, interest rate and exchange rate were mixed depending on the country. Wongbangpo and Sharma (2001) also observed that macroeconomic variables Granger cause stock market movements in all five ASEAN countries suggesting that the values of these stock indexes are functions of past and current values of macroeconomic variables since they constitute the information set used to generate a flow of expected future income.

Ibrahim and Aziz (2003) analysed the link between stock prices and four macroeconomic variables for Malaysia. The empirical results suggest a long term positive relationship real output and price level with the stock market. The long run exchange rate and money supply, however, reflect a negative relationship with the stock market. Moreover, they found the dynamic responses of the stock prices to changes in macroeconomic variables spell inefficiency in the Malaysian equity market and accordingly, investors may gain by exploiting information contained in macroeconomic variables for investment decisions in Malaysia.

Karamustafa and Kucukkale (2003) investigated the long run relationship between stock market returns and macroeconomic performance in Turkey. The data used in their study was the stock price index of the Istanbul Stock Exchange and a set of macroeconomic variables, including money supply, exchange rate of the U.S. Dollar, trade balance and the industrial production index. Obtained results illustrated that stock returns are cointegrated with a set of macroeconomic variables by providing a direct long run equilibrium relation. However, the macroeconomic variables are not the leading indicators for stock returns as no causal relation was determined.

Gunsekaraage et al. (2004) examined the macroeconomic variables influence on the stock market in Sri Lanka and found the consumer price index has a significant negative influence and money supply has a positive significant influence on the stock market. The interest rate has a negative impact and the exchange rate does not seem to have any influence on stock prices. The VECM analyses provided some support for the argument that lagged values of macroeconomic variables have an influence on the stock market.

Chaudhuri and Smiles (2004) found evidence of long run relationships between real stock price and measures of aggregate real activity including real GDP, real private consumption, real money and the real price of oil in the Australian market; however, the causality was not probed.

Macroeconomic variables and their stock market interactions were examined in New Zealand by Gan et al. (2006) on a monthly basis with the New Zealand stock index. It was found that a relationship existed and the causality of stock returns is determined in the long run by the interest rate, money supply and real GDP with inflation. Exchange rate and domestic retail oil price were, however, not significant.

Money supply and interest rates and their relationship with stock prices were investigated by Wong, Khan and Du (2006) for Singapore and U.S. The Johansen multivariate cointegrated system and Granger causality was used with the results suggesting that Singapore's stock prices generally display

a long run equilibrium relationship with interest rate and money supply (M1) but a similar relationship does not hold for the U.S. It was found that the stock market leads these macroeconomic variables and therefore stock markets may be used by the central banks as an indicator to adjust monetary policy.

Brahmasrene and Jiranyakul (2007) examined the relationship between stock market index and selected macroeconomic variables during the post-financial liberalisation (pre-financial crisis) and post financial crisis in Thailand. For the post financial liberalisation, the Johansen cointegration test showed at least one cointegrating or long run relation between the stock market index and a set of macroeconomic variables. Money supply had a positive impact on the stock market index while the industrial production index, the exchange rate and oil prices had a negative impact. During the post-financial crisis, cointegration existed between the stock market index and macroeconomic variables. In addition, the Granger causality test indicated money supply was the only variable positively affecting the stock market returns.

Finally, Humpe and MacMillan (2009) modelled the long term relationship between industrial production, the consumer price index, money supply, long term interest rates and stock prices in the U.S. and Japan. In the U.S., they found stock prices are positively related to industrial production and money supply and negatively related to both the consumer price index and a long term interest rate. In Japan, it is found that stock prices are influenced positively by industrial production and negatively by money supply, consumer price index and the long term interest rate. No Granger causality testing was done.

2.3 South Africa

The South African literature analysing the relationship and causality between returns on the South African stock exchange and macroeconomic variables is fairly limited and varied according to different modelling techniques used.

Hsing (2011) examines the effects of selected macroeconomic variables on the stock market index in South Africa. The exponential generalised autoregressive conditional heteroskedasticity (GARCH) (Nelson, 1991) model is applied. It finds that South Africa's stock market index is positively influenced by the growth rate of real GDP, the ratio of the money supply to GDP and the U.S. stock market index. It is negatively affected by the ratio of the government deficit to GDP, the domestic real interest rate, the nominal effective exchange rate, the domestic inflation rate, and the U.S. government bond yield.

Odhiambo (2011) uses ARDL-Bounds testing procedure to identify the dynamic causal relationship between the stock market development and economic growth in South Africa from 1971-2007. Through cointegration and Granger causality, the overall finding finds the causal flow from stock market development to economic growth to predominate. This is consistent with the conventional supply leading response in which the financial sector is expected to precede and induce the real sector development.

Gupta and Modise (2011) modelled macroeconomics with South African stock return predictability. They report that for in-sample forecasts, interest rates, the money supply and world oil production growth, have some predictive power in the short run. For out-of-sample forecasts, the interest rates and the money supply exhibit short-run predictability, and the inflation rate shows a strong out-of-sample predictive power. However, when accounting for data mining, both the in-sample and the out-sample test statistics become insignificant at all time horizons.

Bonga-Bonga and Makakbule (2010) investigate the relationship between stock returns and macroeconomic variables taking into account asymmetric adjustment behaviour in the stock market. The study applies the Smooth Transition Regression (STR) model through cointegration to account for smooth asymmetric response of stock returns from economic variables. The study, from 1988 to 2006, found the FTSE/JSE All Share Index dividend yield being significant and of relevance to this study, the rand / dollar exchange rate being insignificant.

Alam and Uddin (2009) examine the empirical relationship between stock index and interest rates for fifteen countries, one of which being South Africa, by using time series and panel regressions. For South Africa, it was found that there was a negative relationship for interest rates and share price as well as for changes of interest rate with changes of share price. However, the causality between the two was not investigated.

Mangani (2008a) used an augmented GARCH model to investigate effects of the discount rate and gold price on the JSE. It was found that both the discount rate and the gold price impacted on mean returns. A contracting monetary policy lowered stock returns and gold price increases escalated FTSE/JSE All Share Index returns.

Moolman and du Toit (2004) use cointegration and error correction techniques to evaluate the long term equilibrium of the JSE and find that the South African stock market is determined according to the expected present value model. It is therefore implied that it is driven in the long term by economic fundamentals. According to the results found, the long term level of share prices is

determined by discounted future dividends. Short term fluctuations are caused by short term interest rates, the rand/ dollar exchange rate, the Standard & Poor's 500 Index, the gold price and a risk premium. It is also found that the degree to which stock returns depend on macroeconomic variables, depends on the state of the business cycle in South Africa.

Jefferis and Okeahalam (2000) used a cointegration and error correction techniques to model the stock markets of South African, Zimbabwe and Botswana. They used quarterly data from 1985 to 1995. The results indicated that for South Africa, real stock prices are positively related to the real exchange rate and real GDP and negatively related to long term interest rates. Interestingly, it was found that while in all cases stock markets are influenced by domestic economic growth, there are no common patterns beyond this.

Secondly, Jefferis and Okeahalam (2000) found that for South Africa the main transmission of international influences is through the real exchange rate and that there was no long term relationship with either U.S. GDP or real foreign interest rates. However, the causality of all of the above relationships was not investigated.

Van Rensburg (1999) analysed relationships between the returns on the JSE, industrial and gold indices. The results show that long term interest rates, the gold and foreign reserve balance and the balance on the current account are influential on the returns of all three indices.

Van Rensburg (1998) used bivariate Granger causality tests to estimate the causal relationships between the stock market and macro economic variables and found that that equity returns are forward looking. Therefore, equity returns lead changes in the growth rate of sector earnings and other variables representing aggregate economic activity and not the other way around.

Van Rensburg (1995) estimated linear relationships between the FTSE/JSE All Share Index and unexpected changes in the term structure, unexpected changes in the gold price, unexpected changes inflation expectations and unexpected returns on the New York Stock Exchange (NYSE). The results of which, point towards all four factors being influential on the stock market returns.

Barr (1990) uses a factor analytic approach and identifies the gold price, short term interest rate, foreign stock markets and local business confidence as variables that influence returns on the South African stock exchange.

3. Hypothesised model

According to Chen, Roll and Ross (1986), the selection of applicable macroeconomic variables is based on their hypothesised effect on either the cash flows or / and the required rate of return as per valuation models. This study draws on existing theory and empirical evidence when deciding on which variables are appropriate.

The level of real economy activity is proxied by GDP as per Cheung and Ng (1998), Wongabanpo and Sharma (2001), Chundri and Smiles (2004), Gan et al. (2006) and previously in South Africa by Hsing (2011) and Jefferis and Okeahalam (2000). South African GDP is only being made public on a quarterly basis. An increase in output may increase future expected cash flows and subsequent profitability. Thus, it is initially expected that a positive relation between stock prices and GDP will exist and that GDP will have a causal effect on the JSE.

It is hypothesised that there will be a negative relation between inflation and stock prices. Inflation raises a firm's production costs and therefore decreases its future cash flow which lowers revenue as well as profits. Inflation would also likely serve tightening economic policies which would have an adverse effect on profits and stock price. This study employs the CPI as a measure of inflation. This is consistent with Mukherjee and Naka (1995), Maysami and Koh (2000), Nasseh and Strauss (2000), Wongbangpo and Sharma (2001), Ibrahim and Aziz (2003), Gunsekaraage et al. (2004), Gan et al. (2006) and Humpe and MacMillain (2009). Locally, Gupta and Modise (2011) and Van Rensburg (1995) investigated this effect in South Africa.

Interest rates directly change the discount rate in the valuation model and influences future cash flows. An increase in interest rates raises the required rate of return which, in turn, inversely affects the value of the asset. Additionally, the opportunity cost will increase from a portfolio allocation perspective of holding equities and therefore encourage the purchasing of alternative assets to equities. There should then be an inverse relationship between the interest rate and stock prices. The interest rate is measured is used by Bulmash and Trivoli (1991), Mukherjee and Naka (1995), Kwon and Shin (1999), Karamustafa and Kucukkale (2003), Nasseh and Strauss (2000), Maysami and Koh (2000), Gan et al. (2006), Brahmasrene and Jiranyakul (2007) and Humpe and MacMillain (2009). In South African studies, Jefferis and Okeahalam (2000), Alam and Uddin (2009), Mangani (2008a), Jefferis and Okeahalam (2000) studied this effect.

The rand/dollar exchange rate is hypothesised as being inversely related to the stock price index (eg. an appreciation of the rand versus the dollar would negatively affect the stock price index). This is

due, firstly, to the inflation differential that South Africa has with the dollar meaning that the rand, over a period of time, loses its value due to inflation. Secondly, the impact of currency depreciation will increase exports causing the competitiveness and subsequent profits of South African listed companies resulting in higher stock market value. Internationally, exchange rates have been examined through studies by Mukherjee and Naka (1995), Kwon and Shin (1999), Karamustafa and Kucukkale (2003), Maysami and Koh (2000), Wongbangpo and Sharma (2001), Ibrahim and Aziz (2003), Gunsekaraage et al. (2004), Gan et al. (2006) and Brahmasrene and Jiranyakul (2007). For South Africa, Hsing (2011), Gupta and Modise (2011), Bonga-Bonga and Makakbule (2010) and Jefferis and Okeahalam (2000) have examined this factor.

The role of money supply may have either a positive or negative effect on stock prices as shown by Mukherjee and Naka (1995), Cheung and Ng (1998), Kwon and Shin (1999), Maysami and Koh (2000), Wongbangpo and Sharma (2001), Karamustafa and Kucukkale (2003), Ibrahim and Aziz (2003), Gunsekaraage et al. (2004), Chaudhuri and Smiles (2004), Gan et al. (2006), Wong, Khan and Du (2006), Brahmasrene and Jiranyakul (2007) and Humpe and MacMillain (2009). South African studies using money supply have been conducted by Hsing (2011) and Gupta and Modise (2011). The money supply may increase due to inflation and therefore may have a negative relation with stock prices. However, the increase in money supply creates an excess supply of money and then an excess demand for equity through portfolio allocation which results in increase in stock prices.

4. Data

Data is sourced from I-Net Bridge, a leading South African provider of economic and financial market data. It is analysed on a quarterly basis due to some data only being available on this basis. The data set runs from July 1965 to July 2010 which consists of 180 observations for each variable constituting the longest period of time analysis study of its kind in South Africa. Inflation (CPI) and GDP show strong seasonality and therefore seasonally adjusted data are used. Seasonally adjusting the data removes the seasonal element of a time series which is appropriate when one is examining for non-seasonal trends. Failure to do so may lead to inaccurate subsequent results. Table 1 and 2 illustrate the data used and the subsequent manipulation required.

Table 1	
<u>Definitions of variables</u>	
<u>Variables</u>	<u>Definitions of Variables</u>
LOGALSI	Natural logarithm of the index of quarterly-end closing prices. for all shares listed on the Johannesburg Stock Exchange
LOGZARUSD	Natural logarithm of the quarterly-end exchange rate of the South African rand to U.S. Dollar
LOGM1	Natural logarithm of the quarterly-end M1 money supply in South Africa.
LOGCPISA	Natural logarithm of the quarterly-end Consumer Price Index.
LOGGDPSA	Natural logarithm of the quarter-end Gross Domestic Product of South Africa.
LOGSAGOV10	Natural logarithm of the quarter-end yield on 10-year long term South African long term government yield.

Table 2	
<u>Definitions of time-series transformations</u>	
<u>Transformation</u>	<u>Definitions of Time-Series Transformations</u>
$\Delta \text{LOGALSI}_t = \text{LOGALSI}_t - \text{LOGALSI}_{t-1}$	Quarterly change of the natural logarithm of JSE All Share Index closing price.
$\Delta \text{LOGZARUSD}_t = \text{LER}_t - \text{LER}_{t-1}$	Quarterly change of the natural logarithm of the exchange rate of the rand to U.S. Dollar
$\Delta \text{LOGM1}_t = \text{LM1}_t - \text{LM1}_{t-1}$	Quarterly change of the natural logarithm in the M1 Money Supply.
$\Delta \text{LOGCPISA}_t = \text{LOGCPISA}_t - \text{LOGCPISA}_{t-1}$	Quarterly change of the natural logarithm in the Consumer Price Index.
$\Delta \text{LOGGDPSA}_t = \text{LOGGDPSA}_t - \text{LOGGDPSA}_{t-1}$	Quarterly change of the natural logarithm in Gross Domestic Product.
$\Delta \text{LOGSAGOV10}_t = \text{LOGSAGOV10}_t - \text{LOGSAGOV10}_{t-1}$	Quarterly change of the natural logarithm on 10 year Government Bond Yield.

5. Empirical Methodology

Cointegration analysis (Johansen, 1991) is used to determine the long term relationship between macroeconomic variables and the stock market. Verbeek (2008) notes that cointegration is a statistical property of a time series. Variables are cointegrated if they each share a common trend or they share a certain type of similarity in terms of their longterm fluctuations, but they may not automatically move together and may be otherwise unrelated.

According to Zhou (2001), defining long run relationships and subsequent interpretations from cointegration depend on both the length of time of the study as well as the number of observations. Analysing the results of the study, Zhou (2001) findings indicate that using a small sample of 30 to 50 annual observations, instead of more observations of higher frequency data, may not only result in significant loss of the test power but also very likely experience the problem of size distortion. It was additionally found that a test with a small number of years and observations make the results very sensitive to the lag length used and is more easily effected by the problem of under-parameterisation. This paper therefore avoids these potential pitfalls by employing an extended number of years as well as an adequate frequency with a low lag length when testing the data and the subsequent interpretations from the findings of this paper.

To apply standard testing procedures in a dynamic time series model, it is normally required that the respective variables are stationary since most econometric theory is built upon the assumption of stationarity according to Verbeek (2008). Stationarity is defined by Challis and Kitney (1991) as a quality of process in which the statistical parameters such as the mean, standard deviation autocorrelation etc. do not change with time and depends on the lag alone at which the function was calculated. Without the normal distribution, the subsequent time series analysis may give incorrect results. When time series data does not follow the normal distribution due to fluctuations, that data is then non-stationary.

The non-stationarity of a series can influence its behaviour and properties substantially. Verbeek (2008) stipulates that regressing a non-stationary variable upon another non-stationary variable may lead to spurious regression. A spurious regression refers to occurrences that have no causal connection yet it may be inferred that they do, owing to an underlying third factor. Thus the correlation between two variables is misleading as it does not entail causation.

According to Joshi and Shukla (2009), when one is dealing with non-stationarity, the t-ratios will not follow a t-distribution, so one cannot correctly test the regression parameters. Secondly, if the series

is consistently increasing over time, the sample mean and variance will grow with the size of the sample, and they will always underestimate the mean and variance in future periods. If the mean and variance of a series are not well defined then neither are its correlations with other variables. When testing time series models, the implication that non-stationary variables can lead to spurious regressions means that some form of testing of cointegration is almost mandatory (Harris, 1994).

However, the use of non-stationary variables does not necessarily result in invalid estimators as an important exception arises when two or more variables are cointegrated. If the non-stationary variables exist in a particular linear combination that is stationary then a long run relationship between these variables exists, according to Verbeek (2008).

The first step of the process of testing for long run relationships between variables involves a test for stationarity and the order of the integration of the variables is estimated. The Augmented Dickey-Fuller (ADF) and Phillips-Perron tests for unit roots are used in order to do this.

Once the order of integration of each variable is determined, the next step is to calculate the optimal lag length for the Vector Auto Regression (VAR) as all results in the VAR model depend on the right model specification.

As explained by Liew (2004), an auto regressive process with a lag length p refers to a time series in which its current value is dependent on its first p lagged values. However, the autoregressive lag length p is always unknown and therefore it has to be estimated through a lag length selection criterion such as the Akaike's information criterion (AIC) (Akaike 1973) or Schwarz information criterion (SIC) (Schwarz 1978) amongst others.

The importance of lag length determination criteria is shown by Braun and Mittnik (1993) who illustrate that the approximation of a VAR whose lag length is contrary to what the actual correct lag length should be leads to inaccurate results. Granger causality, impulse response functions and variance decompositions that may be calculated from the estimated VAR are similarly affected.

Additionally, Lütkepohl (1993) points out that selecting a higher order lag length than the actual correct lag length causes an increase in the mean-squared forecast errors of the VAR. Selecting a lower value lag length than the true lag length frequently generates autocorrelated errors. Hafer and Sheehan (1989) also find that the accuracy of forecasts from VAR models can vary considerably when using miss specified lag lengths.

Subsequently, when using Johansen (1991) cointegration, Banerjee et al. (1998) propose the number of cointegrating vectors generated by the Johansen approach may be sensitive to the number of lags in the VAR and therefore one needs to determine the best lag length.

For this study, owing to the large sample size, the SIC is most appropriate owing to its superior large sample properties as per Myung, Tang and Pitt (2009), Azzem (2007), Burnham and Anderson (2002) and Johnson and Scott (1999).

5.1 Cointegration

Once the appropriate lag length is defined, cointegration is applied to determine whether the time series of the variables display a stationary process of a shared linear trend as per Verbeek (2008).

Engle and Granger (1987) provide a means for testing for cointegration in a single equation structure and the Johansen (1991) method enables testing for cointegration in a system of equations. Although Engle and Granger's two-step error correction model can be used in multivariate context, the VECM gives more efficient estimates of cointegrating vectors (Phillips, 1991).

The Johansen procedure is based on the VECM to test for at least one long run relationship between the variables. This step breakdown is consistent with, amongst others, Mukherjee and Naka (1995), Maysami and Koh (2000), Wongbangpo and Sharma (2001), Ibrahim and Aziz (2003), Gunsekaraage et al. (2004) and Humpe and MacMillan(2009).

According to Maysami and Koh (2000), the VECM is a full information maximum likelihood model which therefore permits the testing for cointegration in a whole system of equations in one step and which does not require a specific variable to be normalised. This means that it avoids carrying over the errors from the first step into the second and gives more efficient estimators of cointegrating vectors, as would be the case if Engle and Granger's methodology is used. It also has the advantage of not requiring *a priori* assumptions of endogeneity or exogeneity of the variables.

The following Johansen multivariate model is used to calculate the relationships between the variables;

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \dots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \mu + \Phi D_t + \epsilon_t \quad (1)$$

where $\Gamma_i = -I + \Pi_1 + \Pi_2 + \dots + \Pi_i$ for $i = 1, 2, k-1$; (2)

$$\Pi = -I + \Pi_1 + \Pi_2 + \dots + \Pi_k \quad I \text{ is an identity matrix} \quad (3)$$

ΔX_t is the first difference of the time series variable. The matrix Γ_i comprises the short term adjustment parameters, and matrix Π contains the long term equilibrium relationship information between the X variables. The Π could be decomposed into the the product of two n by r matrix α and β so that $\Pi = \alpha\beta$ where the β matrix contains r cointegration vectors and α represents the speed of adjustment parameters. In this way, the impact matrix Π is found as the coefficient of the lagged levels in a nonlinear least squares regression of ΔX_t on lagged differences and lagged levels. The maximisation over the parameters $\Gamma_1, \dots, \Gamma_{k-1}$ therefore leads to an ordinary least squares regression of $\Delta X_t + \alpha\beta X_{t-k}$ on the lagged differences as per Johansen (1998) and Gan et al. (2006)

5.2 Granger Causality Test

Once the relationship between the macroeconomic variables and the FTSE/JSE All Share Index has been established, the next objective of this study is to observe whether the macroeconomic variables selected for this study are valuable in predicting future stock market movements in South Africa. Granger causality is a test used to determine whether one time series can forecast another. Roebroek et al. (2005) describe Granger causality as quantifying the usefulness of unique information in one time series in predicting values of the other. Specifically, if incorporating past values of x improves the prediction of the current value of y , then x Granger causes y . Therefore, precedence is used to identify the direction of causality from information in the data.

Roebroek et al. (2005) go on to explain that the VAR model can be thought of as a linear prediction model that forecasts the current value based on a linear combination of the most recent past influential variables. Thus, the current value of a component is predicted based on a linear combination of its own past values and past values of other components. This shows the value of the VAR model in quantifying Granger causality between groups of components.

The practicability of the Granger causality test depends on the stationarity of the system. If the series is stationary, the null hypothesis of no Granger causality can be tested by the standard Wald tests as shown by Lutkepohl (1991). Additionally, because Granger causality requires large sample sizes to make conclusions, it should be evaluated over a long time period.

Gan et al. (2006) illustration of Granger causality is used to test the lead- lag relationship between the macroeconomic variables and the FTSE/JSE All Share Index;

$$\Delta X_t = \alpha_x + \sum_{i=1}^k \beta_{x,i} \Delta X_{t-i} + \sum_{i=1}^k \omega_{x,i} \Delta Y_{t-i} + \varphi_x ECT_{x,t-i} + \epsilon_{x,t} \quad (4)$$

$$\Delta Y_t = \alpha_x + \sum_{i=1} \beta_{y,i} \Delta X_{t-i} + \sum_{i=1} \omega_{y,i} \Delta X_{t-i} + \varphi_y ECT_{Y,t-i} + \epsilon_{y,t} \quad (5)$$

where ΔX_t and ΔY_t are the first difference of time series variable while φ_x and φ_y are the parameters of the ECT term, measuring the error correction mechanism that drives the X_t and Y_t back to their long run equilibrium relationship.

Furthermore, Gan et al. (2006) stipulate that the null hypothesis for (4) is $H_0: \sum \omega_x = 0$ which suggests that the lagged terms ΔY do not belong to the regression. Conversely, the null hypothesis for the equation (5) is $H_0: \sum \omega_y$, that implies the lagged terms ΔX do not belong to the regression and these hypotheses are tested using a F-test.

5.3 Innovation Accounting

Innovation accounting such as the impulse response function and variance decomposition is used in analysing the interrelationships among the variables chosen in the system as per Gan et al. (2006). Accordingly, this study proceeds to evaluate variance decompositions and impulse-response functions based on the VAR specification to capture the dynamic interactions among the variables as per international studies by Wongbangpo and Sharma (2001), Ibrahim and Aziz (2003), Nasseh and Strauss (2000), Chundri and Smiles (2004), Gunsekaraage et al. (2004) and Gan et al. (2006). As far as I am aware, this is the first use of innovation accounting in assessing macroeconomic variable influence on stock market returns in South Africa.

5.3.1 Impulse response functions

A shock to the i -th variable not only directly affects the i -th variable but it is also transmitted to all of the other endogenous variables through the dynamic lag structure of the VAR. An impulse response function traces the effect of a one-time shock function to one of the innovations on current and future values of the endogenous variables. Therefore, the impulse response describes the South African FTSE/JSE All Share Index reaction to the shock in the macroeconomic variables and the subsequent periods in time after.

If the innovations ϵ_t are contemporaneously uncorrelated, interpretation of the impulse response is as follows as stated by Shachmurove and Shachmurove (2008): The i -th innovation $\epsilon_{i,t}$ is simply a shock to the i -th endogenous variable $y_{i,t}$. However, innovations are generally correlated, and may be viewed as having a common component which cannot be associated with a specific variable. In

order to interpret the impulses, it is common to apply a transformation P to the innovations so that they become uncorrelated with the formula being

$$v_t = P e_t \sim (0, D) \quad (6)$$

where D is a diagonal covariance matrix.

5.3.2 Variance decompositions

The impulse response function trails the effect of a shock to one variable on the other variables in the VAR. The variance decomposition, however, separates the variation in between the South African macroeconomic variables into the constituent shocks to the VAR. Variance decomposition shows how much of the forecast error variance for any variable in the VAR is explained by innovations to each explanatory variable over a series of time horizons.

Variance decompositions are constructed from a VAR with orthogonal residuals and hence can directly address the contribution of macroeconomic variables in forecasting the variance of stock prices as originally proposed by Sims (1980). Cointegration implies that R squared approaches 1 and therefore the variance decomposition in levels approximates the total variance of stock prices.

Enders (1995) states the proportion of Y variance due to Z shock can be expressed as:

$$\frac{\partial_{z_t}^2 [a_{ij}(0)^2 + a_{ij}(1)^2 + \dots + a_{ij}(n-1)^2]}{\partial_y(n)^2} \quad (7)$$

According to Enders (1995) a_{ij} represents the coefficients of lagged values of variable j on variable i with n being the forecast horizon. Enders (1995) and Gan et al. (2006) show that as n period increases the $\partial_y(n)^2$ also increases. Further, this variance can be separated into two series: y_t and z_t series. Consequently, the error variance for y can be composed of e_{y_t} and e_{z_t} . If e_{y_t} approaches unity it implies that y_t series is independent of z_t series. It can be said that y_t is exogenous relative to z_t . On the other hand, if e_{y_t} approaches zero (which indicates that e_{z_t} approaches unity) the y_t is said to be endogenous with respect to the z_t as per Gan et al. (2006).

6. Empirical Results

6.1 Cointegration Analysis

Cointegration requires the variables to be integrated to the same order and therefore the Augmented Dickey-Fuller (ADF) and Phillips-Peron tests are used. The results of the tests are given in Table 3. Both ADF and Phillip-Perron do not reject the null hypothesis of the existence of a unit root in log levels of all variables and therefore it indicates the presence of non-stationarity which may lead to spurious relationships.

They do, however, reject the same null hypothesis in the log first difference of the series that therefore indicates that GDP, inflation (CPI), money supply, rand / dollar exchange rate and the interest rate (10 year government bond yield) are integrated of order one, I(1). Therefore, since the various variables exhibit stationarity the study may continue.

Table 3					
<u>Augmented Dickey-Fuller Test Results</u>					
<u>Null Hypothesis: LOGCPISA has a unit root</u>			<u>Null Hypothesis: LOGGDPSA has a unit root</u>		
	t-Statistic	Prob.*		t-Statistic	Prob.*
Augmented Dickey-Fuller test	-1.28439	0.6365	Augmented Dickey-Fuller test	-1.1628	0.6901
First Differenced			First Differenced		
	t-Statistic	Prob.*		t-Statistic	Prob.*
Augmented Dickey-Fuller test	-3.50302	0.009	Augmented Dickey-Fuller test	-4.99569	0
<u>Null Hypothesis: LOGM1 has a unit root</u>			<u>Null Hypothesis: LOGSAGOV10 has a unit root</u>		
	t-Statistic	Prob.*		t-Statistic	Prob.*
Augmented Dickey-Fuller test	0.338204	0.9797	Augmented Dickey-Fuller test	-1.87944	0.3414
First Differenced			First Differenced		
	t-Statistic	Prob.*		t-Statistic	Prob.*
Augmented Dickey-Fuller test	-14.0106	0	Augmented Dickey-Fuller test	-11.5893	0
<u>Null Hypothesis: LOGZARUSD has a unit root</u>					
	t-Statistic	Prob.*			
Augmented Dickey-Fuller test	-0.24608	0.9288			
First Differenced					
	t-Statistic	Prob.*			
Augmented Dickey-Fuller test	-12.0026	0			

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

Subsequently, before testing the VAR for cointegration, the lag length criterion needs to be specified. The optimum lag length suggested by SIC was 1 and therefore this lag restriction on the VAR is used.

In selecting the lag length, a requirement is that the error terms for the equations must be uncorrelated. Therefore, this paper uses the Ljung-Box-Pierce Q statistic to test the null hypothesis that the error terms are uncorrelated. The subsequent results indicate the lack of autocorrelation in the residuals and therefore the model is adequately specified.

The results of Johansen cointegration test are reported in Table 4. Accordingly, there are 3 cointegrating equations at the 5% level of significance.

Table 4				
Sample (adjusted): 1965Q4 2010Q2				
Included observations: 179 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LOGALSI LOGCPISA LOGGDPISA LOGM1 LOGSAGOV10 LOGZARUSD				
Lags interval (in first differences): 1 to 1				
<u>Unrestricted Cointegration Rank Test (Trace)</u>				
Hypothesised				
No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.407646	181.2234	95.75366	0
At most 1 *	0.192776	87.48980	69.81889	0.001
At most 2 *	0.135510	49.15625	47.85613	0.0375
At most 3	0.079733	23.09320	29.79707	0.2415
At most 4	0.041139	8.219767	15.49471	0.4422
At most 5	0.003904	0.700160	3.841466	0.4027
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Johansen and Juselius (1990) note that the first cointegrating vector that corresponds to the largest eigenvalue is the most correlated with the stationary part of the model and therefore will be its most useful. Hence, in this long run study, the analysis is based on the first cointegrating vector.

After normalising the coefficients of the FTSE/JSE All Share Index to one in order to establish the long run relationship of the variables against the FTSE/JSE All Share Index from 1965-2010, the relationship can be expressed as;

$$ALSI = -7.548GDP + 0.322CPI + 2.452M1 - 2.433SAGB10 - 1.140ZARUSD$$

These estimated long run coefficients of the macroeconomic factors may be interpreted as elasticity measures since the variables are expressed in natural logarithms. From these results, one is able to interpret the long term relationship for the past 45 years and offer possible theoretical explanations for the relationship, but not the causality, between the FTSE/JSE All Share Index and the macroeconomic variable.

6.2 Causal Analysis

When dealing with a cointegrated set of variables, Granger (1988) recommends that the causal relations between the variable should be investigated within the structure of the VECM. The empirical investigation of testing for causality relations has been carried out for the period July 1965 to July 2010 with the lag values of the macroeconomic variables tested for forecast ability for future stock market returns. The lag value, as previously stated, was one according to SIC and tested against the 179 observations for each variable. We perform two statistical tests, the pair wise Granger Causality test and the Block Exogeneity Wald test.

We use the pairwise Granger Causality test to identify the exogeneity of each variable introduced in the system. The p values indicate the significance of lagged coefficients of each variable in the equation of each first differenced endogenous variable.

The Block Exogeneity Wald Test was used to test the joint significance of each of the other lagged first differenced endogenous variables in each equation and also to test for the joint significance of all the other lagged first differenced endogenous variables in each equation. This is useful to see whether the lagged values variables (such as x and z) would be jointly and significantly influencing y. The causal test statistics are shown in the table below.

Table 5	
<u>VECM Pairwise Granger Causality / Block Exogeneity Wald Tests</u>	
Sample: 1965Q2 2010Q2	
Included observations: 179	
Dependent variable: D(LOGALSI)	
<u>Excluded Variable</u>	<u>Probability</u>
D(LOGCPISA)	0.0763
D(LOGGDPSA)	0.1397
D(LOGM1)	0.2491
D(LOGSAGOV10)	0.5782
D(LOGZARUSD)	0.4249
All	0.1149

The results of the tests for the causal relationship between the input variables and the FTSE/JSE All Share Index and the using pairwise Granger causality test are as follows:

Table 6	
<u>Granger Causality - Causality Relationships</u>	
CPI does not Granger Cause	—————→ ALSI
GDP does not Granger Cause	—————→ ALSI
M1 does not Granger Cause	—————→ ALSI
SAGOV10 does not Granger Cause	—————→ ALSI
ZARUSD does not Granger Cause	—————→ ALSI

Therefore, one is able to infer that none of the macroeconomic variables independently has a direct influence on the FTSE/JSE All Share Index over the period June 1965 to June 2010. The null hypothesis (that there is no Granger causality) cannot be rejected at a 5% significance level.

To confirm the results above, the block exogeneity test results can be examined to test the joint significance of each of the lagged endogenous variables in each equation. It is represented by the word "All" in Table 5 above which is the p value of the χ^2 Wald statistic for joint significance of all other lagged endogenous variables in the equation. Similarly, this test fails to reject the null hypothesis as the p-value of the causality is insignificant at the 5% level.

It can therefore be concluded that none of the macroeconomic variables has significant Granger causality for the FTSE/JSE All Share Index. This implies that in South Africa the value of the FTSE/JSE All Share Index is not a function of the past and current macroeconomic factors analysed in this paper and that these variables do not constitute useful predictive information for the FTSE/JSE All Share Index price level.

6.3 Innovation Accounting

6.3.1 Impulse Response Function

An impulse response function traces the effect of a one-time shock function to one of the innovations on current and future values of the endogenous variables. Therefore, the impulse response describes the FTSE/JSE All Share Index reaction as a function of time to the macroeconomic factors at the time of the shock and the subsequent points in time thereafter. The results of the impulse response analysis of the South African macroeconomic variables and the FTSE/JSE All Share Index are shown below.

Table 7					
<u>Impulse Response Analysis</u>					
Response of the stock prices (to one standard deviation shock in macroeconomic variables)					
Periods ahead	LOGCPISA	LOGGDPSA	LOGM1	LOGSAGOV10	LOGZARUSD
2	0.002313	0.004117	-0.005798	-0.005527	0.004252
4	0.005572	0.010032	-0.012373	-0.012211	0.010522
12	0.009288	0.016122	-0.00699	-0.010302	0.013721
20	0.010047	0.016549	0.001435	-0.001084	0.005543

The forecast period is the first column and is the period of time forecasted ahead, namely bi-annually, annually, 3 years and 5 years respectively due to the data supplied being quarterly. As expected given the lack of causality, a one standard deviation shock in any of the macroeconomic variables has an inconsequential effect on the JSE. For example, the response of the stock exchange two quarters or 6 months after one standard deviation shock in the macroeconomic variable is 0.2%, 0.4%, -0.5%, -0.5% and 0.4% for CPI, GDP, money supply, interest rate and rand / dollar exchange rate respectively.

6.3.2 Variance Decomposition

The impulse response function trails the effect of a shock to one variable on the other variables in the VAR. The variance decomposition, however, separates the variation of the South African macroeconomic variables into the constituent shocks to the VAR. Variance decomposition shows how much of the forecast error variance for any variable in the VAR is explained by innovations to each explanatory variable, over a series of time horizons.

Ordering of the variables is of importance given the causal influence that they have on the relevant stock index. However, given that South Africa's macroeconomic variables and the FTSE/JSE All Share Index have been shown to have a non causal relationship, the ordering becomes less important.

According to Sims (1980), the power of the Granger causality can be ascertained by the variance decomposition. In the South African example one would therefore expect that due to the lack of Granger causality shown between the FTSE/JSE All Share Index and the macroeconomic variables there would be a very small portion of a variable, such as the money supply, that would explain the forecast error variance of the FTSE/JSE All Share Index. The decomposition between the FTSE/JSE All Share Index and South African macroeconomic variables is shown below.

Table 8							
<u>Variance Decomposition Analysis</u>							
Forecast error variance of the ALSI (explained by innovations in the macroeconomic variables)							
Periods ahead	S.E.	LOGALSI	LOGCPISA	LOGGDPSA	LOGM1	LOGSAGOV10	LOGZARUSD
2	0.155739	99.56896	0.022063	0.069866	0.138617	0.125966	0.074528
4	0.199324	97.5621	0.134847	0.434861	0.712914	0.679844	0.475437
12	0.252154	88.13933	0.978001	3.091362	2.183362	2.669988	2.93796
20	0.263911	83.64311	1.967446	5.829448	2.076281	2.778053	3.705661

The variance decomposition analysis should compare favourably with the impulse response analysis. The table format shows separate variance decompositions for each endogenous variable. The "S.E." in the second column is the forecast error of the FTSE/JSE All Share Index at the given forecast horizon. The source of this forecast error is the variable in the current and future values of the innovations to each endogenous variable in the VAR. The remaining columns give the percentage of the forecast variance due to each innovation, with each row adding up to 100%.

As expected, given the lack of Granger causality results and poor explanatory impulse response analysis results, the macroeconomic variables account for little influence on future stock prices. For

instance, over 12 quarters or 3 years, the influence of the macroeconomic variables on the future stock price is 0.98%, 3.09%, 2.18%, 2.67%, 2.4% for CPI, GDP, money supply, interest rate and rand / dollar exchange rate respectively with the multitude of other factors incorporated in the FTSE/JSE All Share Index accounting for 88.14% of the influence on future stock price movements.

7 Interpretation of results

7.1 Overview of results

The results of this study do not correspond to the expected hypothesised result of a causal relationship from the macroeconomic factors to the JSE. However, this may not be as unusual as it would initially seem for South Africa. The macroeconomic variables were selected based on economic theory and comparable international studies as discussed in Chapter 3. A necessary caveat to the selection of the variables is that theory and practise do not always align: macroeconomic variables do not operate in isolation from the stock market and both the variables and the market may be affected by a multitude of exogenous factors not incorporated into this specific analysis. The argument made above is especially pertinent to South Africa given its unique history, its role in international markets, the data used in this study as well as general investment idiosyncrasies.

A key dependent for the macroeconomic variables relationship to be incorporated within stock market return is based on the efficiency of taking the information into account and the speed at which it occurs. According to research such as Jefferis and Smith (2005) and Appiah-Kusi and Menyah (2003), the South African stock market is not fully efficient and therefore does not incorporate all given information. With regards to the information availability, the frequency of data used in this study is quarterly since GDP data is only released in this manner. This means that there would be a higher likelihood of the stock market integrating other market noise generated in a quarter. There is also a significant time lag for some of the variables (such as GDP) from the end of the measurement period to when the information is officially released lending itself to criticism of pertinence of the past information due to the lag.

Secondly, South Africa was subject to political and policy changes over an extended period of time. Apartheid (1948-1994) resulted in the South African market being ostracised by the world with long term damaging effects to the economy. The country was also subject to numerous, and often conflicting economic policies that may have been influential in the non-causality result as per Aron, Elbadawi and Kahn, 2000) and the De Kock Commission (1984).

Thirdly, behavioural finance issues could influence the relationship and causality. Both internationally and locally, markets are subject to irrationality through extreme exuberance and pessimism. These intangible aspects are recognised features influencing stock market returns worldwide through studies such as Lakonishok et al. (1994) and Daniel et al. (1998, 2001) which could well negate, or even contradict economic variable information transmission. Similar

behavioural finance issues are shown to be an effect on the South African stock exchange by Gaffney (2009) and Van Rensburg and Robertson (2003b).

Lastly, notwithstanding South Africa's political and economic isolation during a substantial portion of the period of this study, the JSE was still influenced by world events to a certain extent. This would have become especially prevalent from the mid-1990's when South Africa became an open economy hence becoming more influenced by contagion and interdependence between international stock markets. Additionally the price of precious metals, specifically gold, would also likely be influential.

Given the above, there appears to be ample broad supportive empirical evidence lending credibility for the lack of causality found in this study from the selected macroeconomic variables to stock returns in South Africa.

7.1.1 Data frequency and market efficiency

Frimpong (2011) suggests the possibility of using macroeconomic factors to predict stock prices depends on how fast the market incorporates the new macroeconomic information. The Efficient Markets Hypothesis (EMH) as originally proposed by Fama (1970) states that the market is aware of all information available, both current and past, and that the information is incorporated into the prices of the stock index and individual shares.

As such, it is neither possible to earn abnormal returns nor to outperform the index on a consistent basis. Therefore, it is logical that the previous macroeconomic factors' statistics would not drive stock returns over the long term as those factors have been priced into the returns implicitly and inherently.

However, this proposition is controversial and seems to conflict with prior research, particularly in the case of a developing economy such as South Africa. Appiah-Kusi and Menyah (2003) found that the South Africa's stock market prices do not adjust rapidly to the arrival of new information – which conforms to earlier findings from Roux and Gilberston (1978). Further research by Jefferis and Smith (2005), Jefferis and Okeahalam (1999b), Smith et al (2002) and Magnusson and Wydick (2002) all found the South African stock market to be weak form efficient.

A stronger argument was made by Flannery and Protopapadakis (2002) who stated that a possible reason for a lack of a causal relationship between macroeconomic variables and the stock market may be due to the stock market excluding important sources of wealth that are not traded or the returns are not measured. The effect of this proposition contradicts the efficient market hypothesis.

Fung and Lie (1990) also noted this effect and stated that macroeconomic variables cannot accurately predict stock market price movements because of the inability of stock markets to fully capture all information relevant to the change in the underlying macroeconomic fundamentals. In addition, Flannery and Protopapadakis (2002) suggest that the amount of information incorporated into stock returns over time frames would make the specific macroeconomics difficult to detect. Ebrahim and Fratzher (2004) also questioned the ability to account for a singular factor over extended intervals between time periods without inherently taking into account other influential factors in the stock exchange returns.

This is pertinent as the data frequency used for this study was quarterly, given the available frequency of the necessary macroeconomic variables. It is trite that a wealth of other information applicable to the stock market would be forthcoming during this time frame; furthermore, such additional information might not be predicated upon the macroeconomic variables.

7.1.2 Political and policy changes

South Africa has had significant political and policy changes throughout the course of this study. Apartheid and subsequent trade sanctions, limited capital flows and discrimination of the majority of the population during a significant part of this study would likely be influential on the results.

When discussing causality and the discovered lack thereof between the macroeconomic variables and stock returns, De Beer and Keyser (2007) note that South Africa's politics, which resulted in international isolation, lead to a domination of the JSE by resources and specifically mining companies. De Beer and Keyser (2007) speculate this dominant position, particularly of the gold mines, could be the reason that the JSE did not reflect overall economic conditions for an extended period. The De Kock Commission (1984) found that monetary, fiscal and exchange rate policies had been in conflict with one another and Aron, Elbadawi and Khan (2000) observed that fiscal policy in particular had not been aligned with other policies for extended periods.

7.1.3 Behavioural finance

Another possible reason for the lack of causality between the macroeconomic factors and the JSE may be the impact of behavioural finance on the relationship between the variables and the stock market. Behavioural finance, according to De Bondt et al. (2008), aims to bridge neoclassical finance and cognitive psychology by studying investors' decision making behaviour through observed departures from the traditional finance theory. Akintoye (2008) defined behavioural finance as how

cognitive or emotional biases, which are individual or collective, create anomalies in market prices and returns and other deviations from the EMH.

Stock market performance is prone to exuberance and pessimism. Market bubbles and crashes tend to exhibit this clearly where the underlying fundamental value and macroeconomic indicators may not show any significant standard deviations to the norm, yet prices either spiral or collapse owing to apparent investor irrationality.

De Bondt and Thaler (1985) provided an initial study with an overreaction hypothesis showing that investors overreact and drive share prices abnormally higher or lower depending on market information. Lakonishok et al. (1994) found similar evidence of the market overreacting and underreacting based on new information received; this observation contravenes the efficient markets hypothesis.

There are also expectations built into investors' mindset although previous returns are not necessarily an indication of future performance. Siegel (1998) suggests these expectations may therefore be already factored into stock prices at the start of the valuation period that may prove overly optimistic or pessimistic and limit possible future correlations.

Daniel et al. (1998, 2001) show overconfidence causes overreactions and self attribution (where one attributes success to competence and failures to bad luck) maintains overconfidence and allows prices to continue to react excessively, creating momentum. Barberis et al. (1998) and Hong and Stein (1999) both found similar results for the cause of unwarranted momentum on stock markets. Hong et al. (2005) suggest the dependency on models to forecast and evaluate stocks may lead to incorrect decisions due to the model not incorporating all the necessary information.

Both Chiang et al. (2008) and Frimpon (2011) believe the influence of rumour, sentiment or herding behaviour can negatively influence and even lead to a lack of causality between macroeconomic factors and the stock market. These studies demonstrate how influential behavioural finance is in international markets and it is a probability that South Africa would have similar behavioural issues.

Locally, Griffin et al. (2003) show that South Africa, amongst 30 countries, shows evidence of positive momentum investing and Beukes (2010) shows that there is evidence of a value premium in South Africa which demonstrates a lack of rationality. Gaffney (2009) also showed a value premium in South Africa contrary to the EMH as the efficient market should not be able to provide investors with the opportunity to earn abnormal returns. Gaffney's (2009) result is consistent with Graham and Uliana (2001) and Van Rensburg and Robertson (2003b). This suggests that the South African

market is not efficient and also shows how investment decisions have cognitive or emotional biases which could negate the extent to which macroeconomic factors influence the JSE.

7.1.4 Global factors influencing the local market

An additional potential reason for the lack of causality is that the JSE is influenced by local and global factors. Samouilhan (2006) segregates this influence between interdependence and contagion amongst the markets. He defines interdependence or integration as the correlation of asset prices and volatility between stock exchanges. Contagion, as defined by Collins and Biekpe (2003), is the increase in the correlations of asset prices and volatility during a period of turmoil.

There are numerous studies both internationally and in South Africa that have examined both the contagion and interdependence effects. The JSE-focused studies found correlations to the international markets as shown by Piesse and Hearn (2002), Piesse and Hearn (2005), Collins and Biekpe (2003), Collins and Abrahamson (2004) and Samouilhan (2006). Therefore, one is able to ascertain that owing to international markets being influential on the local stock market, the South African macroeconomic variables may have had a subdued effect on the JSE returns.

Lastly, the global diversification of listed companies in terms of revenues, costs and profits would similarly diversify the effect of local macroeconomic variables on local stock market returns as observed by Siegel (1998). For example, it is estimated that over 50% of JSE listed companies' revenues are generated internationally and would therefore be less likely to be influenced by local macroeconomic conditions.

The combination of the various factors discussed above makes the result of this study, with the specific macroeconomic variables lacking causality for South African stock market returns, plausible. However, by analysing each macroeconomic variable individually, one may attain further insight into the results found in this paper.

7.2 Individual Macroeconomic Variables

7.2.1 GDP

GDP has a significant negative relationship with the FTSE/JSE All Share Index over the long run and has a lack of causality for stock market returns. This may seem counter intuitive as one would initially hypothesise that an increase in output may increase future expected cash flows and subsequent profitability which, in turn, would cause earnings per share (EPS) growth translating into stock price increases and thus having a positive relationship and positive finding of causality from macroeconomic variables to South African stock returns. International studies such as Cheung and Ng (1998), Wongabanpo and Sharma (2001) and Chundri and Smiles (2004), Gan et al. (2006) have shown some evidence of a positive relationship or causality between the two and similarly in South Africa by Hsing (2011), Moolman and du Toit (2004) and Jefferis and Okeahalam (2000). However, the hypothesised result has not occurred in this study.

There are a variety of possible reasons that could account for the result. Siegel (1998) suggests part of the negative correlation between stock returns and GDP growth is that economic growth is largely factored into stock prices at the start of the valuation period but in some high growth countries such as India currently (and Japan historically), investors' valuations proved excessively optimistic. In addition, Ritter (2005) suggests that the markets assign higher price-to-earnings and price-to-dividend multiples when economic growth is expected to be high, which has the effect of lowering realised returns because more capital must be committed by investors to receive the same dividends.

Seigel (1998) found that from 1970 to 1997 the correlation between stock returns and GDP growth was -0.32 for seventeen developed countries and -0.03 for eighteen emerging markets. Dimson et al. (2002) calculated a correlation coefficient of -0.27 across 16 countries over 101 years and Ritter (2005) replicated the study on different data and also found a negative correlation across 16 countries.

In addition, Dimson et al. (2002) showed that South Africa's equity had the third highest real return out of 16 countries over 103 years. This could lead to optimism of future JSE returns which might disappoint given the volatility of the returns throughout the long run time frame as opposed to consistent high real returns that investors may expect.

As previously speculated, the data frequency of the availability of GDP on a quarterly basis as well as the lag of when the official growth percentage is released versus when it actually occurred may be

influential in negating its relevance. The South African stock market is not fully efficient and therefore does not incorporate all given information. The quarterly release of GDP results may also mean that there would be a higher likelihood of the stock market integrating other market noise generated in a quarter.

Another possible reason for the lack of causality is suggested by Siegel (1998), who notes the largest firms quoted on most countries' stock markets are multinationals whose profits depend on worldwide conditions, rather than purely domestic economic growth. Therefore, parts of the production process for these multinational companies are not reflected in the country's GDP and this can create a discrepancy between a company's performance and the local economy. This may have merit given the environment in which the South African stock market operates. Many of South Africa's listed shares, particularly the top 40 shares on the FTSE/JSE All Share Index, are diversified internationally. Resource shares such as Anglo American and Sasol historically and more recently companies such as SAB Miller and MTN have been accruing significant income offshore. It is currently estimated that over 50% of revenue generated on the JSE is not accrued in South Africa. Therefore, the offshore income stream would be somewhat diversified from South Africa's economic performance and accordingly, it is unlikely that these shares' performances will match the underlying GDP growth of South Africa in the long run.

The drivers of South African economic growth and of stock market returns may also not be the same, particularly given that the JSE, historically and still to this day, is dominated by the top 10 shares. As an example, the top 10 shares currently account for approximately 60% of the FTSE/JSE All Share Index and account for R1 out of every R2 traded on the JSE. Over the significant length of this study, mining shares have had a particularly dominant influence on FTSE/JSE All Share Index returns. Given this, the FTSE/JSE All Share Index may perhaps be unlikely to provide a true reflection upon general economic performance of South Africa as a whole. Additionally, earnings per share and dividend yields are noted as being key for individual share growth yet this may not be reflective of general economic state of a country.

Further literature reviewed showed the result of this study is not as inconsistent as initially suspected due to somewhat counter intuitive results. Stock and Watson (1990, 1998), Hu (1993), Binswanger (2000, 2004), Ritter (2005), Mao and Wu (2007), Kaplan (2008), Dimson et al. (2010), Saldanha (2010) all show that the impact of GDP on stock market performance is either negligible or nonexistent.

Ritter (2005) states that future economic growth is practically irrelevant for the prediction of future equity returns. This is based on the theory that long run equity returns and economic growth are driven by different factors. Long run equity returns depend on dividend yields and the growth per share dividends. On the other hand, economic growth comes from technological change and either from reinvesting earnings into existing firms or the infusion of cash into new firms. Dimson et al. (2010) add the factors of population increases and growth per capita GDP when discussing the influential factors of GDP growth and why they found that macroeconomic factors do not lead stock returns.

Ritter (2005) further argues that the infusion of cash into new firms does not result in a higher growth rate of dividends per share for existing firms. Technological changes benefit consumers and labour, rather than the owners of capital, thus negating equity returns but increasing economic growth. Buffet (1999) and Sigel (1999, 2000) observe that in a competitive economy, technological change largely benefits consumers (through a higher standard of living) rather than the owners of capital. Furthermore, these authors agree about the dispersion between long run equity returns and economic growth.

Ritter (2005) concludes his argument by proposing that if individuals save more and invest their savings, the increased amount of capital per worker will result in higher real wage rates, which is of no benefit to the owners of shares in existing corporations. Economic growth does result in a higher standard of living for consumers, but it doesn't necessarily translate into a higher present value of dividends per share for the owners of the existing capital stock.

Dimson et al. (2002) also suggest that a significant part of economic growth comes from new enterprises and not the high growth of existing enterprises which leads to a dilution of GDP growth before it reaches shareholders. This is supported by Bernstein and Arnott (2003) who stated that there is a difference between growth in aggregate earnings of an economy and the growth in earnings per share to which current investors have a claim. These growth rates are not necessarily equivalent, since there are factors that can dilute aggregate earnings.

Additionally, Saldanha (2010) states that emerging stock markets may not be representative of their relevant economies and that the stock market is influenced by the size of the domestic economy, stock market structure and valuations. Saldanha (2010) found EPS growth in emerging markets had a much larger impact on share prices than GDP. Saldanha (2010) also argued that the causal effect of GDP on equity markets was negligible.

A part of GDP growth comes from capital increases such as initial public offerings (IPO's) and rights issues which increase aggregate earnings but which are not available to current investors because of their predated current holding. In general, investors do not instantaneously participate in the profits of new companies. As explained by Barra (2010), when buying shares of new businesses, investors have to dilute their holdings in the "old" economy or invest additional capital. This dilution causes growth in EPS available to current investors to be lower than growth in aggregate earnings.

Binswanger (2004) found that the stock market and real economic activity were not related-owing to the effects of speculation. Bhide (1993) suggests that speculation in the stock market may decrease investment efficiency which has a detrimental consequence on economic growth. Deverux and Smith (1994) observe that the stock market can discourage economic growth because risk sharing through worldwide stock markets may diminish the saving rate. Mauro (1995) points out that the expansion of stock market will reduce economic growth through the erosion of the public's precautionary savings.

Finally, Azarmi et al. (2005) also suggest that political, legislative and regulatory domestic restrictions on the economy were significant factors in the negative correlation between GDP and the stock market in India. This observation could be transferred to South Africa and may hold some merit given the apartheid related international and local restrictions placed on the economy.

According to the International Development Research Centre (IDRC) report (2005), the burden of sanctions cost the South African economy significantly. Rising costs of maintaining the apartheid state, the weakening economy and tax base meant severe debt was imposed on the country. International sanctions ranged from arms embargo, trade sanctions and restrictions on capital flows also weakened the economy.

During the 1960's the South African economy grew at some 6% per annum, while total employment grew in line with population growth at 3% per annum. However, by the late 1980's the real economy was shrinking, as was formal sector employment according to Carter and May (2001). Furthermore, the IDRC states in the isolated conditions of the 1980s, compounded by growing disinvestments by foreign firms, a small number of South African conglomerates seized almost total control of the economy. By the end of that decade, five groups controlled companies' worth close to 90% of the stock market value of all public companies based in South Africa.

Two significant factors were influential to the South African apartheid economy, namely gold and manufacturing. As per the IDRC, gold contributed more than a third of South Africa's exports, which,

together with other mining, came close to half of South Africa's exports and South Africa's share of 'western bloc' gold output remained as high as 75%.

The gold vulnerability on the South African economy was exposed with the end of the gold standard in 1971 which the IDRC attributed to multiple factors including the volatile gold price, decreasing gold production, the liberalisation of international markets and the subsequent effect of gold losing its allure as well as greater competition from other gold producing countries.

Carter and May (2001) state that by placing a ceiling on the job and income earning possibilities for non-whites, apartheid maintained artificially low levels of inequality among the non-white population. The IDRC quantified this by stating that non-white progression through professions or salaried employment was blocked as they were prevented from advancing beyond semi skilled occupation classes. They were also not allowed to own shares in public listed companies.

The combination of debt, economic trade sanctions, gold volume and price decline and the majority of the population being discriminated against and unable to invest on the stock exchange may prove that these restrictions on the economy could be influential in the negative correlation between GDP and the stock market in South Africa through the historical legacy of apartheid.

There is limited South African research analysing the specific relationship between the stock market and GDP. Dimson et al. (2010) show real dividend growth has lagged behind real GDP per capita in 82 national stock markets including South Africa from 1900-2009. Dimson et al. (2010) also ascertained that economic growth has little to do with future stock market returns. Odhiambo (2009) found that there was a causal relationship from the stock market's development to economic growth but not vice versa from 1971-2007.

However, Moolman and du Toit (2005) found a positive relationship from 1978-2000 whilst Aron and Muelbauer (2002), despite finding a positive relationship, never found it to be very significant. Hsing (2011) does find a positive influence by GDP on the JSE but used a GARCH model to attain this result. A correlating factor between Dimson et al. (2010) and Odhiambo (2009), who found a lack of causality, and this study is the time period that each study was examined under was a considerably longer time frame than those that found a positive result which increases the likelihood of the above issues being influential on long term findings that this study initially set out to test.

Given the mixed results both internationally and locally and with the insightful reasoning into the lack of causality between GDP and the stock market, it is perhaps not surprising that over the long

period on which this study is based, these factors would explain the negative relationship and non-causality result.

7.2.2 Inflation, money supply and interest rates

Inflation, money supply and interest rates tend to be closely related through monetary policy and liquidity effects, thus making it difficult to assess the specific influence of these variables independently. Over the time period of this study, South Africa has followed multiple monetary policies in order to achieve and sustain various objectives. In addition to this lack of policy consistency, the monetary, fiscal and exchange rate policies have been at times in conflict with one another (De Kock Commission, 1984). Fiscal policy in particular has not been aligned for extended periods of time (Aron, Elbadawi and Kahn, 2000).

According to Jonsson (2001), the South Africa Reserve Bank (SARB) used money supply directly to affect liquidity conditions in the 1970s before moving to a more mixed system in the early 1980s where there was indirect control of the money supply through adjustments of short term interest rates. From the mid 1980s through to 1994, Jonsson (2001) observes that owing to political unrest, the SARB announced a more direct monetary targeting system where the growth of broad money supply was focused on in order to bring an increasing inflation rate down. However, this explicit money growth target was frequently missed and continued to be missed by wide margins post 1994; however, inflation was contained. In February 2000, South Africa moved to a more formal inflation targeting framework for monetary policy. This inconsistent manipulation of three macroeconomic variables at various and often separate times is likely to be influential in the result of the non-causality of these factors.

Secondly, Alatiqi and Fazel (2008) explain through the theory of the liquidity effect in which macroeconomic variables act as a transmission mechanism from one variable to another and in the end actually counteract each other and their effect on the market. For example, when there is an increase in money supply an excess of supply of cash is created which results in an increase in price levels and hence inflation. However, this increase in the supply of money should cause interest rates to increase in order to keep the money market in equilibrium. This equilibrium effect should be approximately neutral in the long term and therefore a particular variable does not itself have a significant real effect on the stock market due to other variables counteracting its effect on stock returns.

Ahmed (2008) goes further and assumes that if the money demand remains constant, an increase in money supply, which through the above stated transmission mechanism, raises interest rates which increases the opportunity cost of holding cash as well as stocks. The security of being offered more stable returns at a higher rate than previously available would mean that potential investors on the stock market would switch out into interest bearing deposits with a negative consequence on stock markets.

Lastly, Eframnn and Fratzher (2004) state that there are limitations when using structural VAR models and longer frequencies (such as monthly or quarterly) for analysing monetary policy effects. Eframnn and Fratzher (2004) cite research from Rigobon and Sack (2002 and 2003) that states that monetary policy reacts to stock market movements by taking the impact of the aggregate demand into account. However, the causality between monetary factors and equity prices runs in both directions. Eframnn and Fratzher (2004) show that not accounting for this endogeneity may introduce a significant bias in empirical estimations of the equity returns reaction to monetary policy. Given the above listed reservations, one can endeavour to assess each variable separately.

7.2.2.1 Inflation

Inflation was initially hypothesised with having a negative relationship and causal effect on stock market returns by raising a firm's production costs and therefore decreasing its future cash flow which lowers revenue as well as profits. The results of this study show that there is in fact a positive relationship but a lack of causality from inflation to JSE returns.

Inflation in South Africa has been, by and large, a dominate focus on various governments throughout the period of this study due to the eroding effect it has on real wealth, amongst other reasons. Given this historical level of importance placed on the inflation figure, forecasting the future inflation and its subsequent effects is a standardised factor taken into account therefore limiting the future predicative value of the inflation figure. Additionally, shares are generally thought of as a useful hedge to inflation and therefore if there are future concerns about inflation, investors may be proactive about their portfolio holding allocation to account for this.

The ability of stock prices to maintain their purchasing power as a long run hedge against inflation is the subject of extensive research in empirical finance. Fisher's (1930) proposition states the expected rate of return is composed of a real return plus an expected rate of inflation and therefore the relationship should be positive in the long run. The theory follows that higher prices increase

the revenues of firms meaning higher earnings which intuitively should lead to an increase of stock market prices.

However, several empirical studies find returns are in fact inversely related to inflation such as those found by Fama and Schwert (1977), Fama (1981), Geske and Roll (1983) and Chen et al. (1986). Over an extended period of time though, there is evidence to the contrary.

Jaffe and Mandelker (1976) report a negative relationship between annual stock returns and concurrent rates of inflation over short sample periods but a positive relationship over a much longer period (1875-1970). The latter positive long term inflation effect is confirmed by Boudoukh and Richardson (1993), who examine stock returns and inflation using one year and five year holding-period returns between 1802 and 1990 in the U.S. and the United Kingdom.

Further international substantiation of the Fisher effect is evident through Kaul (1987) who maintains that a pro-cyclical monetary response leads to the positive correlation between stock returns and inflation, while Hess and Lee (1999) point to a demand shock emanating from an imbalance in the aggregate demand and supply of the economy that causes a positive relationship between the stock market and inflation.

Anari and Kolari (2001) found similar results for six industrialised countries (U.S., Canada, United Kingdom, France, Germany and Japan) from 1953 to 1998. The preliminary response of the stock market relationship with inflation was negative in all six countries and thereafter become positive and permanent with long run Fisher elasticities ranging from 1.04 to 1.65. This indicates that the stock relationship is composed of a positive real return on top the expected return of inflation over the long run.

Al-Khazali and Pyun (2004) provide evidence of the long-term Fisher effect on stocks in nine Pacific-Basin markets from 1980 to 2001: Australia, Hong Kong, Indonesia, Japan, South Korea, Malaysia, the Philippines, Singapore and Thailand. Regression analysis on the nine markets shows negative relationships between stock returns in real terms and inflation in the short run, while co-integration tests on the same markets display a positive relationship between the same variables over the long run. The long run Fisher elasticities of stock prices with respect to inflation are in the positive range of 1.02 to 1.67 across the nine countries under study.

According to Bodie (1976), equities are a hedge against inflation as shares are a claim on real underlying assets. If the underlying assets rise in value due to inflation, so should the price of the share by a similar amount and therefore the real change should be unaffected.

Ioannides et al. (2005) articulates that firms are in a position to predict their profit margins and since equities are claims on current and future earnings it also follows that the stock market operates as a hedge against inflation, at least in the long run. Subsequently, the real value of the stock market is immune to inflationary pressures as it is already priced into the future price of the market. Lee (1992) found similar causality issues when he identified that there was no causal relation between stock returns and inflation. Therefore he found that using inflation to predict stock market returns from 1947 to 1987 in the U.S. was not a reliable indicator.

The South African evidence also supports Fisher (1930) and Bodie's (1976) hypothesis that equities are a hedge against inflation. Bethlehem (1972) examined returns from 1951 to 1971 on the JSE and found that South African equities were indeed an inflation hedge. Roome (1986) examined real returns from 1960 to 1985 which was a far higher inflationary period in South Africa. The results of this paper confirm equities' role as a hedge for inflation. Filer and McLeod (1999) show over a longer period of time from 1925 to 1998 the hedging properties of equities and Dimson et al. (2002) supported this relationship through their analysis from 1900 to 2000.

Bernanke and Gertler (1999 and 2001) show empirically how Federal Reserve acts in a pre-emptive manner in order to address future inflation concerns with no independent response to stock prices in the U.S. SARB is the central bank of South Africa. Its primary goal according to its mission statement is achieving and maintaining price stability in the South African economic system. Whilst historically it has not always been successful and there have been wide diverges from what is wanted and what is reality, the forecasting of what will transpire in terms of expectations of inflation has been relatively accurate, thus lending credibility for Ioannides et al. (2005) proposition of expectations being built into future returns.

Given the evidence supporting the hedging property of South African equities and the likelihood of future inflation expectations being built into return expectations, the non causality finding for inflation and stock returns is plausible.

7.2.2.2 Money Supply

Money supply also has a positive relationship with the FTSE/JSE All Share Index. The hypothesised model of this paper was non-committal owing to the inconclusive results in previous papers across the countries previously examined. The argument that this relationship could be negative was underpinned by previous studies in multiple countries such as Ibrahim and Aziz (2003), Wongbangpo and Sharma (2001) and Humpe and MacMillan (2007) studies. They speculated that a possible

reason for this was that the money supply may increase due to inflation and therefore may have a negative relation with stock prices.

However, the relationship between the money supply and stock returns is found to be positive and therefore may be speculated with several possible explanations. Firstly, the increase in excess money supply may increase the demand for equity through portfolio allocation which results in increased stock prices. Secondly, as suggested by Mukherjee and Naka (1995), the injections of money supply have an expansionary effect that boosts corporate earnings that then get reflected in the share price. A third possibility is that an increase in money supply has a direct positive liquidity effect on the FTSE/JSE All Share Index. Lastly, as per Fama (1981), increases in real activity that drive stock returns also stimulate the demand for money via the quantity theory model which was restated by Friedman (1956) that increases in money supply growth cause employment and output to increase which would therefore create the positive relation between money supply and stock prices.

However, when examining the underlying causality, despite there being a positive relationship between the two, it is found that money supply does not in fact drive South African stock market returns. This may be due to the South African historic focus on monetary policy and the transparency with which future targets were announced, the relationship between inflation, money supply and interest rates as well as the relationship in South Africa being at times conflicting and finally, the external monetary supply shocks such as gold price and capital flows being influential.

Money supply is often taken as a secondary future effect from either inflation or interest rate effects. Therefore it may be implicitly taken into account when adjusting for either of the above mentioned factors thus limiting its direct causal effect. South Africa has predominately focused its monetary policy on a pre-announced money supply target through the majority of this study. This future indicative policy may mean that once the actual money supply adjustments were made, they were likely to not be influential on future stock market returns due to the adjustments already taking place. The inconsistency in the end objective through the use of money supply in South Africa over the length of this study would also likely impair a clear cut causality relationship from money supply to the stock market.

Alatqi and Fazel (2008), in an international study, stipulated that the hypothesised causal relation from money supply to stock prices is often derived from an assumed negative causal relation from money supply to interest rates which is then followed by an assumed negative causal relation from interest rates to stock prices. Therefore, it is reasoned that the absence of a causal relation from

money supply to stock prices may be partly due to uncertainty over whether interest rates will fall (rise) as a result of an increase (decrease) in the money supply.

Both Ahemd (2008) and Alatiqi and Fazel (2008) found that money supply does not Granger cause stock returns in India and the U.S. These results concur with previous literature from Errunza and Hogan (1998) who examined 5 European countries (Belgium, France, Germany, Switzerland and the U.K), Wing (2005) with the U.S and Karamustafa and Kacukkale (2003) who examined Turkey, all found a lack of causality from money supply to stock returns. Wu (2001) found that money supply does not have any noteworthy role in influencing stock prices in a relatively small economy such as Singapore. Lee (1992) also found causality issues when he identified that since there was no causal relationship between stock returns and money supply growth.

Money supply also affects the monetary policy of central banks. If money supply or inflation goes beyond a usually predetermined level or even approaches this level, central banks will often use interest rates to curb inflation and money supply as shown by Bernanke and Gertler (1999 and 2001).

South African published research on the causality of money supply on the JSE stock returns has been minimal with only one study found examining the causality between the two. The study was done by Gupta and Modise (2011) who found that money supply exhibited short run predictability with the JSE yet over a longer period of time it loses its predictive power. This study concurs with Gupta and Modise (2011) about the lack of predictive power of money supply on stock prices.

According to Aron and Muelbauer (2002), from 1960 to 1999, South Africa has used a monetary policy system where there were pre-announced monetary supply targets solely or in conjunction with repo system and credit controls. Despite not always being successful as per Jonsson (2001), the wide significant margins, where targeted supply was missed, were only in the mid to late 90s; overall a fairly insignificant period over the long term length of the study.

Similarly, the period since 2000, where the repo system has been used, is also minor when one compares these two time horizons of a combined 15 years to the 45 years of the study. During the significant majority of time, the pre-announced expected monetary targets have a strong possibility of being somewhat taken into account to some extent by stock prices.

Aron, Elbadawi and Kahn (2000) also show that the monetary objectives were inconsistent over time and use the example that in some periods the balance of payments was the main focus, while in

others, an anti-inflation stance became the primary objective. These different objectives would have ramifications for money supply and stock price that may not be the similar.

The De Kock Commission (1984) went further and said an influence that is likely to have some implication are the conflicting monetary, fiscal and exchange rate and political policies that were often contradictory. Thus even if the monetary policy of increasing or decreasing supply was targeted, the contradictory nature of other policies means that the possible influential supply of money supply on the stock market may have been somewhat negated.

Lastly, Aron, Elbadawi and Kahn (2000) note that there were many shocks during the extended apartheid era that would have been influential on the economy and the money supply. Shocks such as gold price changes and political crises, resulted in capital investment outflows and intensified trade sanctions. However, the subsequent depreciation of the rand did stimulate the competitiveness of exports, particularly resources which historically have been significantly influential on the JSE returns but yet do not encompass the money supply of the country as a whole. This, together with other literature evidence, seems to indicate that there may be some disparity between the South African money supply and the stock returns.

7.2.2.3 Interest Rates

If interest rates affect the required rate of return and the portfolio allocation, one would expect that the interest rate would lead future stock returns due to the interest rates having future effects on company profits and subsequent share returns, *ceteris paribus*. However, the result of this study indicates that whilst there is an unexpected significant inverse relationship between the South African 10 year Government Bond Yield and JSE, no causality exists from interest rates to stock prices.

In 2000, South Africa moved formally to an inflation targeting framework for monetary policy with the predominate driver of influence being the use of interest rates. Besides for a brief period in the 1980s when short term interest rates were used in a mixed monetary policy system – the majority of the extended length of time over this study - the interest rate has not been a primary influential factor of monetary policy raising the possibility of a lack of direct causality from interest rates to stock market movements.

According to Alatiqi and Fazel (2008), interest rates are the most important determinant of bond prices; however, stock prices are influenced by a multitude of factors. For example, a decreasing interest rate may occur concurrently with an increase in cost of some major company specific inputs

such as commodities (e.g. oil) or labour costs may negate the possible positive effects of lower interest rates.

In South Africa, the stock exchange has historically been overweight in resources companies which are significantly dependent on the various commodity prices when taking into account future profits. South Africa has also been influenced by trade and labour unions such as the Congress of South African Trade Unions (COSATU) that have artificially raised labour costs higher through strikes and similar activities. Both these are just an illustrative example that despite interest rates being an important element in costs, there are other factors to take into account that may influence either revenue or costs.

Bernake and Binder (1992) observe that raising or decreasing interest rates will only be significantly influential to firms that are leveraged through debt. This may constrain or liberate companies that aggressively use gearing. The companies on the JSE tend to have been more conservative in their use of leverage and therefore the direct restraining or invigorating effect of an interest rate increase or decrease may be somewhat muted.

Alatqi and Fazel (2008) further add that the increase or decrease in interest rates garner further expectations about future rates movement. They prescribe that when interest rates either rise or fall, the inverse stock market reaction may not occur and uncertainty influences the negative causality from interest rate to stock prices.

Ehrmann and Fratzscher (2004) mention that the demand side would also be affected if the products produced by the respective companies when demand was highly cyclical or interest rate sensitive would be far more affected by interest rate movements than those that are not.

Ehrmann and Fratzcher (2004) examined that changes in interest rates tend to coincide with changes in business cycle conditions and other applicable economic variables and therefore it is not always clear what is attributable to the change in interest rates and what is attributable to other economic factors. Both Thorbecke (1997) and Patelis (1997) found, depending on the industry and the size of the company, the reaction to U.S. stock returns vary significantly with interest rates.

From a South African perspective, Alam and Uddin (2009) found there was a negative relationship for both interest rates with share price and changes of interest rate with changes of share. However, there was a lack of causality from interest rates to the share price.

Mangani (2009), using a GARCH framework, found the interest rate was important in describing the dynamics of the mean stock market returns on the JSE, however, the GARCH model is focused on short term weekly analysis from 1987 to 2007 as opposed to the longer view of quarterly data of this study. Similar results were found in the study completed by Managni (2008a) a year earlier, again using a GARCH model over short intervals.

Jefferis and Okelhama (2000) also used cointegration and found that interest rates lead stock returns from 1985 to 1995. Van Rensburg (1999) on the other hand, used an APT factor pricing model from 1965 to 1995 and found that equity returns actually lead real activity indicators including interest rates and not the other way around.

Moolman (2004), using an econometric model on a quarterly basis from 1978 to 2000, finds that the long term interest rate does influence future stock returns as the JSE is determined by the present value mode but it does find the degree of influence varies according to the specific business cycle in South Africa. This adds credibility of for Eframann and Fratzcher (2004) proposition to the difficulty of what is attributable to the change in interest rates and what is attributable to other economic factors and therefore may be an influential element in the lack of causality found.

Aron and Muelbauer (2002) found that interest rate effects are possibly capturing the asset channel as well as more direct interest rate transmission channels leaving only a small role for asset prices to be directly influenced by interest rates adding evidence to the presence of the transmission mechanism through the liquidity effect in South Africa. These factors give probable reasoning to why the causality from interest rates to stock returns on the JSE is lacking.

7.2.3 Rand / Dollar Exchange Rate

According to Kutty (2010), the two main theories regarding the relationship between exchange rates and stock prices is the traditional approach and the portfolio adjustment approach. Attributed to Solnick (1987), the traditional approach reasons that currency depreciation will increase exports and therefore profits will increase resulting in a higher stock price. The portfolio adjustment approach argues that the foreign capital flows in and out of a stock exchange is based on momentum. If stock prices are rising in a particular country, they will attract more capital flows and therefore exchange rates are a lag factor.

Whilst the results of this study indicate support for a negative relationship between the rand/dollar exchange and the FTSE/JSE All Share Index, the underlying causality indicates that there is no driving relationship from the rand/dollar exchange rate to the South African stock exchange.

The artificial manipulation of the South African rand value over an extended period of this study is likely to be a factor of the non-causality result due to the lack of true reflection of the economic fundamentals of South Africa. In addition, the varied and even conflicting relationship between exchange rate, fiscal and monetary policies in South Africa could potentially neutralise a causality result. Lastly, exchange rates are often secondary effects from underlying factors. In South Africa's case, factors such as commodity prices and interest rate differentials are likely to be influential in the rand / dollar exchange rate value and these factors are not necessarily transferable into stock returns.

Evidence of no causality from exchange rates to stock returns is found in multiple international papers. Bahmani-Oskooee and Sohrabian (1992) found no long term relationship in the U.S. Ong and Izan (1999) similarly found no relationship for G-7 countries and Australia between exchange rates and their relative stock indexes with Nieh and Lee (2001) confirming the same results for the G-7 countries.

Ajay and Mougoue (1996) found no relationship in Hong Kong, Thailand, Malaysia or Singapore and Abdalla and Murinde (1997) similarly found no relation in another south east Asian country, the Philippines. Bhattacharya and Mukherjee (2003) found no significant relationship between stock prices and exchange rates in India and Muhammad and Rasheed (2003) found no significant relationship in India or Pakistan. Most recently, Tabak (2006) showed that exchange rate does not lead stock market prices in Brazil and Kutty (2010) found that there is no long term relationship between the two variables in Mexico.

According to Aron and Muelbauer (2002), the exchange rate policy in South Africa varied significantly since 1960. The South African rand was pegged to the British pound in the 1960s before moving to a combination of pegging between the pound and the U.S. dollar in the early 1970s. This was then moved to a controlled independent float where the currency was devalued every few weeks between 1974 and 1975 before moving back to a peg system fixed to the U.S. dollar in the late 1970s. Between 1979 and 2000, there was either a combination of managed floating commercial rand and a free floating financial rand or a unified managed floating rand. It was only in 2000 that the rand became free floating.

This artificial and inconsistent manipulation of the currency is likely to be of significant importance as it is prone to mask the true relationship between exchange rates and stock exchange due to the focus of the monetary, fiscal and exchange rate policies differing depending on the key objectives of

the time as per Aron, Elbadawi and Kahn (2000) or even being conflicting as per the De Kock Commission (1984). Even when exchange rate policies may be liberal in attempting to promote growth and subsequent returns on the JSE, the effect of the other macroeconomic policies may have dulled this effect.

Furthermore, Aron, Elbadawi and Khan (2000) found that when looking at these significant influences on the exchange rate policies, the major shocks in gold price changes and political crises resulting in capital outflows and intensified trade sanctions complicated the management of the exchange rate versus the various currencies.

MacDonald and Ricci (2004) found that using cointegration, much of the long run behaviour of the real effective rand / dollar exchange rate of South Africa from 1970 to 2001 is due to real interest rate differentials, GDP per capita (both relative to trading partners), real commodity prices, trade openness, fiscal balance and the extent of net foreign assets. This finding collates with the Balassa-Samuelson effect as identified by both Balassa (1964) and Samuelson (1964), where the effect of a multitude of factors such as productivity and commodity prices, for example, has a knock on effect on to the rand / dollar exchange rate and general wealth of the economy.

Aron, Elbadawi and Khan (2000) found similar results for South Africa from 1970 to 1995 as the explanatory variables for the long run behaviour were terms of trade, the price of gold, tariffs, capital flows, official reserves and government consumption. These results signify that it is not necessarily the rand / dollar exchange rate itself that is the influential factor but the underlying drivers of the exchange rate influence. Depending on the combination and contributing weight of underlying factors, it would therefore not necessarily entail that the rand / dollar exchange rate would be directly influential on the stock market returns. Rather the composite factors of the rand / dollar exchange rate would affect the stock exchange much more broadly than just through the rand / dollar exchange rate.

The above factors add credibility to the non-causality result found in this study.

8. Conclusion

This paper's objective was to find out whether macroeconomic variables explain long term stock market movements in South Africa. The data analysed was from July 1965 to July 2010 on a quarterly basis. The FTSE/JSE All Share Index represented the stock market of South Africa and the macroeconomic variables used were GDP, inflation (CPI), money supply (M1), interest rate (South African 10 year Government Bond Yield) and the exchange rate between the South African rand and the United States dollar.

Using standard international well accepted methodologies when seeking an answer to this examination, the paper employs the Johansen methodology of multivariate cointegration analysis. A finding of cointegration amongst the variables over the long term implies the existence of a long run relationship. Granger causality tests were then done to detect the causal relationships and subsequently innovative accounting was performed in order to evaluate the impulse response functions of one standard deviation shock and the variance decomposition forecast error on the stock prices and macroeconomic variables.

Stationarity is a key attribute in order to perform Johansen cointegration. Using both the Augmented Dickey-Fuller and Phillips Peron tests, it was found that the macroeconomic variables are integrated of order one and therefore the data is stationary. Cointegration was subsequently discovered amongst the variables revealing that there is a long term relationship between the South African stock market and the macroeconomic variables.

According the VECM model estimated in the study, inflation and money supply have a positive relationship with the FTSE/JSE All Share Index over the long run, however, inflation is not significant. A negative relationship was found for the South African 10 year Government Bond Yield (which is used as a measure of the interest rate), the rand / dollar exchange rate and intuitively surprisingly GDP.

The macroeconomic factors influence on stock market returns was next examined. The Granger causality results indicates that the FTSE/JSE All Share Index is not a function of the past and current macroeconomic factors analysed in this paper and that these variables do not constitute useful predictive information for the FTSE/JSE All Share Index price level.

This assessment was then vindicated by use of innovation accounting. Impulse response function traced the effect of a one standard deviation shock of the macroeconomic variables on the South African stock exchange – the results of which were inconsequential. Similarly, variance

decomposition was used to explain the forecast error variance of the FTSE/JSE All Share Index for each individual macroeconomic variable with the results correlating with the previous findings of this study that the macroeconomic variables account for an insignificant portion of future returns.

9. Areas for future research

The paper has analysed the influence of certain macroeconomic variables to stock market returns in South Africa. The finding of noncausality of the factors selected leads one to the question of what actually does influence stock returns significantly if these macroeconomic variables do not.

The influence of precious metals is likely to have some significance on JSE returns based on historic dependency that the South African economy has had on it and the dominating weight of resource shares on the JSE. In addition, markets have become more correlated with one another and it may be interesting to see to what level an influential index such as the S&P 500 or the MSCI World Index would drive the local index, if any.

Another interesting question posed is whether stock market returns, would in fact, lead macroeconomic variables in the long term and therefore whether the JSE is actually a useful predictive tool in assessing future macroeconomic variables.

A further addition would be to see what effect a higher frequency of data would influence the result of this paper. Some previous studies have, due to the limitation of information frequency availability, used proxies for a macroeconomic factor in order to attain more frequent data points. A common example of this that has been used would be substituting GDP, which is published quarterly, with industrial production figure which is published monthly. This may help to reduce the “noise” element prevalent in longer interval periods.

In terms of prior South African research, whilst the relationship has been examined through a variety of methodologies, it would be interesting to see what the results would be of a causality testing in studies such as Alam and Uddin (2009) and Jefferis and Okeahalam (2000). Where some form of causality was tested and found, it would be appealing to see what the results would have been using Granger causality for Moolman and du Toit (2004,) Mangani (2008a) and Bonga-Bonga and Makakbule (2010) results for instance. Furthermore, once causality had been established, it would be interesting to use innovation accounting analysis to examine the extent of this causality influence which no prior studies quoted in this paper have used.

Lastly, it may be perhaps relevant to include structural breaks that may have occurred in South Africa’s unique history, such as the end of apartheid, in order to possibly gain further insight into the relationships independent of structural breaks. Similarly, it may be worth examining the relationship over rolling shorter periods of time to see if there is consistency throughout the periods or whether in fact the macroeconomic variables have influenced JSE returns in certain periods.

10. References

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