

THE EFFECT OF SOUTH AFRICAN AND INTERNATIONAL MACRO-ECONOMIC VARIABLES ON THE SOUTH AFRICAN STOCK MARKET



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I hereby declare that I have read and understood the regulations governing the submission of Master of Commerce dissertations, including those relating to length and plagiarism, as contained in the rules of the University, and that this dissertation conforms to those regulations.

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ABSTRACT

This study aims to answer the empirical question of whether South African and US macro-economic variables are predictors of returns on the South African stock market. The results add to a body of literature, assessing the period from 1996 to 2016, which includes comparative analysis of data pre-and post the 2008 financial crisis. Furthermore, both local and US macro-economic variables are assessed. Variables selected include 1) GDP (SA and US), 2) Interest Rates (SA and US), 3) Inflation (SA and US), 4) South African Money Supply, 5) Rand/Dollar Exchange Rate, and 6) FTSE Index. These variables are assessed on a monthly and quarterly basis, to provide further information on whether the relationships between the selected variables and the stock market are affected by the timing of the data or the level of noise within the data set. The variables are tested using time series Ordinary Least Squares (OLS) regression analysis. This analysis is used to assess predictive relationships. The results show that South African Interest rates and the Rand\Dollar exchange rate have a statistically significant negative relationship with the South African stock market. Additionally, the South African interest rate appeared to hold a more statistically significant relationship with the stock market when the change in the rate was high. Furthermore, the FTSE Index shows a consistent statistically significant positive relationship. These findings provide valuable information to investors who, with further testing to determine exact time lags, can consider these predictive variables when making investment decisions, assuming weak form efficiency exists within the market.

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INTRODUCTION

When making investment decisions an investor is concerned with two details; the current price and the future selling price of the investment. The motive being that any difference between these two amounts represents the gain or the loss on the investment. If an investor can accurately predict the future selling price of an investment, he/she should be able to make better investment decisions.

The study of return prediction has long been of importance to investors and much research has taken place in this field. Past research has focussed efforts on determining whether asset markets are efficient (because without efficiency there may be the potential for return prediction). Research in this area was performed by Fama (1965) who used the Efficient Market Hypothesis theory (EMH) to provide a framework to better understand the relationship between market information and market returns. In addition to this study, research effort has been placed in developing asset pricing models such as the Capital Asset Pricing Model (Sharpe, 1964) and the Arbitrage Pricing Theory Model (Ross, 1976) to assist investors in identifying and taking advantage of mispriced securities. These models have been widely tested in studies that analyse return prediction (Fama, 1990; Ferson & Harvey, 1991; French & Fama, 1989; Groenewold & Fraser, 1997).

Stock price movements occur within an economy and thus should be affected by movements in other market factors namely macro-economic variables. Macro-economic variables form part of the basis of market information and thus have been included in studies using the Capital Asset Pricing Model (Sharpe, 1964) and the Arbitrage Pricing Theory Model (Ross, 1976). Currently, there exists inconclusive evidence as to whether returns on the South African stock market may be predicted by movements in either South African or international macro-economic variables. The inconclusive evidence results in the inability of investors to rely on movements in macro-economic variables having a predictable impact on the South African stock market. This study aims to add to the body of research by exploring the relationship between the stock market and selected macro-economic variables over a 20-year period. The results presented in this dissertation aim to add value by providing more

conclusive evidence in this field which may result in increased confidence in relation to investment decisions, based on macro-economic factor movements.

In addition, this study aims to add value by analysing a recent data set (1995-2016). Analysing data up to the end of 2016. Time series Ordinary Least Squares (OLS) regression analysis will be employed for testing both monthly and quarterly data. Monthly testing is less explored in a South African context due to the lack of available Gross Domestic Product (GDP) data which is only available on a quarterly basis. This increased frequency of data may be able to help reduce “noise” prevalent over longer periods between data points (Geske & Roll, 1983), which may have compromised findings of prior research.

This study will also include a structural break, to account for the global financial crisis which took place (Hsing, 2011). This break may provide for a more reliable analysis of the data. The financial crisis was an abnormal occurrence and as a result, the relationships between the variables tested and their respective predictive ability is likely to be different during this period (Bekiros, 2014). Thus, the inclusion of a structural break allows for the assessment of whether there has been a change in any of the predictive relationships, before and after the financial crisis of 2008.

If any such relationship is found, it would represent an important finding for finance practitioners in relation to their investment trading and asset allocation decisions. Relationships between the selected variables and the stock market may allow investors increased insight into how the stock market is affected by movements in the selected macro-economic factors, resulting in more informed timing of investment decisions.

This study will commence by presenting a review of prior literature. This review will include discussion relating to finance theory supporting the existence of the above-mentioned relationship, in addition asset pricing theories, focussing on the use of macro-economic data, will be discussed. The literature review will then present the findings and conclusions of prior studies conducted in varying contexts. After this discussion, the method of analysis to be utilised in this study will be presented and the mode of testing discussed. The research questions will be posed, following which the

results of this study will be presented to answer these questions. Lastly, the researcher's conclusions based on the results will be presented.

LITERATURE REVIEW

This study aims to explore whether a predictive relationship exists between South African and international macro-economic variables, and the South African stock market. The study will focus its literature review on both international and South African studies that consider the impact of international macro-economic variables on the South African stock market.

This literature review begins by examining finance theory relating to efficient markets. Subsequently, asset pricing models will be considered, focussing on studies that have used macro-economic variables as predictors. Then, the review will conclude by presenting both global and South African research within this field and presenting studies that consider the impact of other markets on South African stock market returns.

RETURN PREDICTION

An investor invests with the objective of earning a return (Correia, Flynn, Uliana, Wormald & Dillion, 2015). The return earned consists of two parts, dividend returns and capital appreciation. Both are influenced by company exposure to systematic risk (macro-economic) and unsystematic risk (firm specific) (Sharpe, 1964). The ability to earn above-market returns has long been in the interest of investors and, consequentially, effort has been focused on finding predictive measures. Such a finding could be used by investors to earn higher investment returns.

To earn returns on the stock market the investor attempts to either predict movements in stock prices or take advantage of mispriced securities (Shleifer & Summers, 1990). To do so, the investor needs a means through which the true value of an asset may be determined. When considering asset valuations, a share in a company is considered to have an intrinsic value at any point in time (Fama, 1965). A share's intrinsic value is dependent on a company's future expected earnings, which, in turn, are affected by the economic environment in which the company operates (Fama,

1965). This evaluation implies that the stock prices and the changes in those stock prices should be related to current and expected movements in macro-economic variables. An investor's ability to take advantage of the influence of macro-economic variables on stock prices is conditional on the level of efficiency within the market.

EFFICIENT MARKETS

Fama (1965) argued that stock prices follow a 'random walk', and as such, investors may only earn a return above the market if they have access to insider information. According to the random walk model, stock prices are subject to movement when new information is made available to the market (Fama, 1970). This new information is assimilated into the market instantaneously (in an information-efficient market). As both the timing and nature of new information are unpredictable, the market price movements are likewise unpredictable and random (Fama, 1965). Therefore, when considering return prediction, the level of information efficiency within the market determines its possibility.

The EMH (Fama, 1965) provides a framework for understanding the relationship between market information and returns. This hypothesis helps illustrate whether it is possible to predict returns on investments given the level of efficiency in the market. When information efficiency is high, Fama (1965) suggests that active trading strategies are of no effect. When considering the real-world applicability of EMH, it is commonly assumed that developed markets are at least 'semi-strong' efficient. This said, there remain many markets (especially emerging markets) that can only be considered to be 'weak-form' efficient (Affleck-Graves & Money 1975, Appiah-Kusi & Menyah (2003), Fama & French, 1989, Kruger, 2011). This lack of efficiency would indicate an opportunity for investors to be earning abnormal returns in the market.

ASSET PRICING THEORIES

The EMH theory is closely linked to both the Capital Asset Pricing Model (CAPM) (Sharpe, 1964) and the Arbitrage Pricing Theory (APT) (Ross, 1976). The EMH (Fama, 1965) suggests that at equilibrium in an efficient market, assets should be fairly priced. These two models (CAPM and APT) provide a framework for determining that equilibrium asset value.

The CAPM (Sharpe, 1964) is a theoretical model for determining the market equilibrium value of risky assets. The concept of market equilibrium relates to the reality that the market price may not always represent an asset's intrinsic value. Deviations from this value, however, will be random and consequentially an investor is unable to consistently take advantage of these deviations to earn abnormal returns (Black, 1972).

Central to CAPM is the notion of risk having two constituents, systematic risk and unsystematic risk. Systematic risk is defined as the risk common to all assets (Sharpe, 1964). It is determined by general influences in the market, over which the investor has no control. CAPM suggests that if an investor was to invest in a fully diversified portfolio, the risk of the portfolio would be a purely systematic risk, as unsystematic risk is reduced via effective diversification (Sharpe, 1964). CAPM additionally proposes that expected asset returns are linearly related to market risk exposure. Thus, expected asset returns are based on the risk-free rate and the premium for bearing risk in relation to that asset. This risk premium is determined by the assets relative exposure to systematic risk (Fama and French, 2004). Systematic risk is informed by market conditions, thus changes in the market due to macro-economic variables may inform asset risk. It follows that a relationship between macro-economic variables and asset prices of assets should exist. Because of this hypothesised relationship, it can be further postulated that there is a potential for these macro-economic factors to be used as predictors of returns in the market.

Where the CAPM model is flawed is in its base set of simplifying assumptions that do not necessarily hold in reality (Roll, 1978). For example, the CAPM model also relies on the assumption that there is an observable market portfolio, consisting of all available assets in the market, both private and public assets, that is measurable (Blitz, Falkenstein, & van Vliet, 2014). While such a portfolio may exist, it is not practically measurable or identifiable in composition on a continuous basis and thus model users need to employ proxies and indices to approximate the market portfolio.

While the CAPM model attempted to find asset prices utilising the risk and return relationship as its basis, the APT model suggests that assets should be fairly priced,

due to the opportunity for arbitrage within the market (Shanken, 1992). Arbitrage takes place when there is a mispriced security in the market. Investors will use the APT model to take advantage of assets which have prices that differ from the theoretical price that is predicted by the model.

The APT model uses the assets' expected returns, along with the risk premium of several other factors, to explain or predict returns for an individual stock (Talla, 2013). Even though the APT model makes use of less simplifying assumptions in comparison to the CAPM model, it still has its critics. The model has no pre-specification for factor selection which decreases its ease of use (Shanken, 1982) i.e. users are required to identify and test variables they may consider to be relevant factors in the model. Studies have previously attempted to use macro-economic variables as inputs within the model (Groenewold & Fraser, 1997; Ikoku & Okany, 2014; Ouma & Muriu, 2014). Using APT, Chen, Roll and Ross (1986) assessed whether macro-economic changes were risks rewarded by returns in the stock market. The results presented macro-economic risk as a source of risk significantly priced into stock market returns. Changes in the risk premium, growth in industrial production, changes in interest rates and changes in inflation were all variables that influenced changes in stock returns (Chen *et al.*, 1986). Using APT, other studies have also found correlation between macro-economic factors and stock returns (Fama, 1990; Fama & French, 1989; Ferson & Harvey, 1991; Groenewold & Fraser, 1997). Specifically, significant relationships with factors such as industrial production, inflation, interest rates and stock returns, were found.

Accurate pricing models aid investors' ability to earn returns in the stock market. Despite prior research and the number of asset pricing models formulated, there is limited consensus as to whether returns are predictable or not, this will be assessed further within this study. The predictability of stock returns has important implications for capital asset allocation and the ability to test for market efficiency.

MACRO-ECONOMIC VARIABLES

An investor can lower his/her exposure to unsystematic risk via diversification, thus the only risk that they should remain exposed to is systematic (Sharpe, 1964). Therefore,

if market-related risk is all that remains, changes in the macro-economic variables within the market should influence a stock price (Chen *et al.*, 1986).

The value of a stock price is often considered the value of the expected discounted dividends (Chen *et al.*, 1986). It follows that any factor which influences the expected cash flows of the company or the discount rate, will affect the stock returns. Therefore, macro-economic factors influencing stock returns will be those that change either the expected cash flow or the discount factor applicable to that stock (Chen *et al.*, 1986).

GLOBAL EVIDENCE

For macro-economic variables to be considered predictors of returns in the stock market, a relationship must first be identified between the selected variables and stock returns. Only after a relationship has been identified can the ability of those variables to predict returns be examined. Some prior literature has attempted to identify relationships between factors, while others have tested for predictability between the variables and the stock market. In this literature review, research on developed markets is discussed initially, after which, literature focusing on developing markets and South Africa is reviewed.

DEVELOPED MARKETS

A developed market for this study is one which has high levels of liquidity, strong economic policy and efficient capital flows (NASDAQ, 2012). As such these markets should exhibit a level of market efficiency as defined by Fama (1970), thus there is expectation that the higher levels of efficiency result in fewer relationships between the market and macro-economic variables and, consequentially, have less predictability in the stock market. Despite this expectation, relationships between macro-economic variables and developed stock markets have been identified.

One such study was conducted by Khan, Wong and Du (2005), who examined both long and short term equilibrium relationships between the major stock indices with selected macro-economic variables, in Singapore and the United States (US). The selected variables; interest rate and money supply, were tested using Johansen's co-integration (Johansen, 1991). This exercise was conducted to identify the existence of a relationship between the chosen variables and stock market returns. The results

indicated a long run equilibrium relationship¹ between the major stock indices and both interest rates and money supply in the Singaporean market, but not in the US.

Like Khan *et al.* (2005), Humpe and Macmillan (2009) used co-integration to examine the relationship between industrial production, inflation, money supply and long term interest rates with stock returns in the Japanese and North American stock markets. Despite the similarities in the variables tested (namely interest rates and money supply) plus the fact that both studies looked at an Asian and the North American market, the results differed. Where Khan *et al.* (2005) found a long run equilibrium relationship with money supply in the US market, no such relationship was found by Humpe and Macmillan (2009). However, Humpe and Macmillan (2009) did establish a long run positive relationship between stock prices and industrial production (real activity) and a long run negative relationship between stock prices, inflation and long term interest rates.

Both the above studies found relationships between selected variables and the stock market, indicating that these markets may not be efficient as defined by Fama (1970). Consequentially, an opportunity for the exploration of predictability between these variables and the respective stock markets may exist. It is noted, however, that the relationships identified differed in each of the studies, despite similarities in test technique and the variables selected. One main difference between the studies was the duration of the time period examined, with Humpe and Macmillan (2009) conducting their testing over a longer period (monthly data testing spanning the period from 1965 to 2005 was used which exceeded the time period in the study conducted by Khan *et al.* (2005) which spanned 1982 to 2005). Thus, this study aims to conduct the testing over as long a period as data availability allows and will aim to break up the period to assess whether the relationships between the selected variables and the stock market change over differing periods.

¹ Long run equilibrium relationships exist where the variables move together in the long run (Stata Handbook,2013) . The long run is dependent on the data set, annual data was utilised in the Johansen (1991) study resulting in a period of 10 years being used to define the long run

Differences in relationships identified are further highlighted by a study conducted by Jareño (2016). Jareño (2016) expanded on the testing of North American data by Humpe and Macmillan (2009) and Khan *et al.* (2005) and examined the relationship between macro-economic variables and the United States stock market during the period from 2008 to 2014. Jareño (2016) found the same relationships between real activity, long term interest rates and stock returns, but not with inflation (which did not have a statistically significant relationship with stock returns). With regard to the Japanese data in the study conducted by Humpe and Macmillan (2009) the results differed from the those of the same tests conducted on the American data. From the Japanese data, it was established that there was also a long-run positive relationship between stock prices and industrial production but a long-run negative relationship between stock prices and money supply. These differences indicate that despite both markets being considered developed, there is a lack of consistency in significance of the relationships across differing economies.

The differences in relationships across economies is further highlighted through studies conducted by Talla (2013) and by Peiró (2015). Talla (2013) investigated the impact of changes in macro-economic variables on stock prices on the Stockholm Stock Exchange, using various modes of testing. Monthly data between 1993 and 2012 was utilised and it was found that both inflation and currency depreciation had a significantly negative influence on stock prices. In addition, interest rates were negatively correlated to changes in the stock price, albeit not significantly.

Peiró (2015) extended the period of testing as well as the geographic scope used by Talla (2013). Peiró (2015) examined the dependence of stock market prices on macro-economic returns in France, Germany and the United Kingdom between 1969 and 2012. The effect of changes in production, inflation rates and interest rates on stock returns were examined using regression analysis. Peiró, (2015) considered both short- and long-term time periods. The results indicated that changes in production and interest rates were determinants of stock prices analysed in all three countries, while price changes were not, a finding that differed from the study conducted by Talla (2013). These two studies indicate the existence of relationships between selected macro-economic variables and stock markets. Additionally, the differences between

the findings indicate the relationships between selected variables and stock markets may not be consistent across all developed markets.

Ekundayo (2015) examined the predictability of the stock market by selected macro-economic variables also using regression analysis. Ekundayo (2015) examined the relationship between stock returns and the dividend-price ratio, the book-to-market ratio, the earnings-price ratio, the interest rate spread, and short term interest rates in the economies of Australia, Denmark, Finland, France, Germany, Japan, Norway, Sweden, the United Kingdom and the United States. Like Peiró (2015), Ekundayo (2015) found stock return predictability when considering short-term interest rates in all of the ten countries examined. Other findings indicated a failure to find consistent short-term predictability with the selected variables. However, dividend yield, earnings yield and interest rate spread could predict stock returns over longer horizons in all the countries, barring Denmark, where it was found that interest rates and interest rate spreads did not hold as predictors of returns.

Overall, the studies reviewed in this literature study indicate limited consistency of evidence or occurrence of predictability. This outcome may be due to the differences in the type of tests performed or the period covered by the data. The limited amount of predictability may also be a result of the examined markets being developed markets which should exhibit higher levels of efficiency. According to the EMH theory (Fama, 1965), this would result in little to no opportunity for predictability to occur. These results may differ in less developed markets.

As developing markets grow and undergo technological changes, however, it is likely that they will become more efficient (Yartey, 2008). This increased efficiency may change the way the market responds to macro-economic events and, thus, it is likely that there will be a difference in the ability of these factors to be predictors of returns. Hence, it is relevant to reflect on both developed and developing market studies.

DEVELOPING MARKETS

The expectation that a developing market is less efficient (Yartey, 2008) than a developed market was contradicted by a study conducted by Gay (2008). Gay (2008) investigated the time series relationship between the stock market indices within four

emerging markets, namely Brazil, Russia, India and China, and the related domestic exchange rate and oil price. Despite these economies being less developed than the ones examined in the aforementioned studies, no significant relationships were found.

Contrastingly, Trivedi and Behera (2012) found significant relationships between equity prices on the Bombay stock exchange and selected macro-economic variables. The macro-economic variables selected included the industrial production index (as a measure of real activity), the wholesale price index, interest rates, money supply, foreign institutional investments and the Morgan Stanley Capital International World Index. The results showed a significant relationship between all these variables and the Bombay stock exchange index. This differing result may have been a consequence of more effective variable selection.

Tripathi (2014) also tested the relationship between stock market performance and selected macro-economic variables in India. Using monthly data over the period from July 1997 to June 2011, both short- and long-run relationships were analysed. Utilising a variety of testing techniques, significant correlations were found between the stock market and macro-economic factors. Three factors specifically identified were inflation rates, interest rates and the exchange rate (the Indian Rupee/Dollar exchange rate). Thus it appears that in the study conducted by Trivedi and Behera (2012) and the one conducted by Tripathi (2014), interest rates held significance, indicating that the Indian stock market's movements may be linked to monetary policy (Tripathi, 2014).

In an African context, Ouma *et al.* (2014) attempted to use the APT and CAPM models to investigate whether macro-economic variables had an impact on stock returns in the Kenyan stock market. Ouma and Muriu (2014) used monthly data over the period from 2003 to 2013. A significant relationship between money supply (a positive relationship), the exchange rate (a negative relationship), the inflation rate (a positive relationship) and returns was found. Furthermore, money supply and the inflation rate were significant determinates in the returns on the Nairobi Stock Exchange using OLS regression analysis. In common with the studies conducted by Trivedi and Behera (2012) and the one conducted by Tripathi (2014), monetary policy tools appear to hold

a significant relationship with the stock market, thus factors representing this monetary tool will be selected for testing in this study.

From the studies reviewed there again appears to be a lack of consistency in the results, with the same factors in each study often yielding different outcomes. This outcome occurs despite these studies being conducted over developing economies where we would expect to see more predictability from lower levels of information efficiency (meaning that there is a greater opportunity for advantage to be taken between the release of new information and when that information is assimilated into the market (Fama, 1965)). As was the case with the studies conducted in a developed market context, the inconsistency in results may be due to differing economic conditions between the economies studied, or even due to differing time periods or test techniques being utilised.

Next, predictability in the South African stock market specifically, will be explored.

SOUTH AFRICA

In South Africa, a recent study conducted by Shawtari *et al.* (2016) examined the long term relationship between the South African stock market and selected macro-economic variables using vector error-correction model techniques. Shawtari *et al.* (2016) used monthly data between January 1988 and August 2010. The variables tested were the inflation rate, the Rand/Dollar exchange rate, real economic activity and money supply. Real economic activity was found to be the most significant determinant of stock prices. Over the 22-year period, real economic activity, inflation, money supply and the exchange rate all showed a relationship with stock prices.

Hsing (2011) performed a similar study with results in alignment with those of Shawtari *et al.* (2016). Hsing (2011) examined the effects of macro-economic variables on the South African stock market using an exponential GARCH model (Nelson, 1991). Much like Shawtari *et al.* (2016), Hsing (2011) found that returns on the stock market index were positively influenced by growth in GDP and the ratio of money supply to GDP, and negatively influenced by exchange rates and inflation. Furthermore, a positive relationship was found between the US stock market index and South African stock market returns together with a negative relationship between the stock market and the

ratio of government deficit to GDP, the real interest rate and the US government bond yield (Hsing, 2011).

Bonga-Bonga and Makakaule (2010) performed a similar analysis and found no relationship between stock returns and the Rand/Dollar exchange rate. The study included the FTSE and S&P 500 index as additional variables in its analysis to capture any relationships between the local and foreign markets. Both international market variables variables were found to hold a significant relationship with the market, but failed to be identified as predictors of returns. Additionally, when investigating the JSE All Share Index (ALSI) return, the ALSI dividend yield was found to be the most important factor when considering stock market returns. The differing result may have been due to the frequency of data used (i.e. weekly) and the length of the period covered (1988 to 2006), both resulting in a larger data set than studies previously mentioned. .

Chinzara (2011) analysed how the systematic risk from the macro-economic environment is absorbed into stock market volatility. This study also considered whether the 2008 financial crisis affected the relationship between the macro-economic variables and stock market volatility. The findings showed that volatilities in short-term interest rates and exchange rates were of highest significance when considering stock market volatility and that the strength of this relationship was heightened during periods of increased volatility. This relationship with volatility indicates a potential ability of exchange rates to be predictors of returns in the South African stock market. The effect of the 2008 financial crisis on relationships between the economy and the stock market is of interest to this study and consequentially it will include a break-analysis of whether the relationships between selected variables before the crisis period are different to those after it.

The mixed findings in literature is further highlighted by Jefferis and Okeahalam (2000) who examined the impact of both domestic and foreign macro-economic factors on the stock returns in the South African, Zimbabwean and Botswanan stock markets. The international factors selected were trade related as these variables were deemed most likely to impact international markets (selected variables include the dollar exchange

rate, US industrial production and US interest rate). The findings were different for each of these markets with only domestic economic factors being common amongst the countries. The impact of foreign macro-economic factors varied for each of the countries examined with the influence of these factors being dependent on the size, market orientation, openness of the economy and the size and liquidity of the stock exchange (Jefferis & Okeahalam, 2000). While the foreign economic variables were considered important, it appears to be the ones related to trade rather than capital flows that were of most importance. This shows little integration between these three capital markets. Jefferis and Okeahalam (2000) also found the stock market index to have a long term positive relationship with real GDP, the real exchange rate, and the real long term interest rate. There was no long-term relationship found between the index and US GDP or real interest rates. The impact of the real exchange rate having a long term relationship was unsurprising due to the relative openness of the South African economy in terms of international trade (Jefferis & Okeahalam, 2000). Similar with foreign interest rates, South Africa has had relatively tight exchange rate controls in capital account transactions in the past (Moolman & Du Toit, 2005). The existence of a relationship between these variables may be possible in the future because these controls have been gradually reduced (Jefferis & Okeahalam, 2000).

Moolman and Du Toit (2005) conducted an investigation into the South African market, analysing a larger number of macro-economic variables. Factors examined included GDP, the gold price, the short-term interest rate, the difference between South African and the US long-term interest rates, the Rand/Dollar exchange rate and the S&P 500 index. It was found that short term fluctuations in the stock market were determined by short term interest rates, the Rand/Dollar exchange rate, the S&P 500 index, the gold price and the differential in long-term interest rates. A notable outcome of the study was that the strength of the relationship between stock returns and the macro-economic variables tested was dependent on the stage in the economic cycle that the market was in.

The relationship between interest rates, the gold price and the South African stock market were confirmed by Mangani (2009). Mangani (2009) examined the effects of the repo rate (as a measure of monetary policy) and gold price changes on individual

stocks listed on the JSE. It was found that interest rates held a negative relationship with stock returns while gold prices had a positive relationship (Mangani, 2009).

Studies that considered return predictability within South Africa include Modise and Gupta (2011), who studied predictability of the South African stock market using macro-economic variables as predictors of returns. Using a predictive regression framework coupled with monthly data over the period from 1990 to 2010, Modise and Gupta (2011) found interest rate variables, world oil production growth, and money supply to have predictive power over short-horizons. This differed from their out-of-sample results, which indicated only interest rates and money supply having short-horizon predictability.

Contrastingly, Macfarlane (2011) examined the quarterly performance of selected macro-economic variables (namely the Rand\Dollar exchange rate, money supply, the inflation rate, GDP and the yield on a 10 year-term government bond) and the stock market over the period 1965 to 2010. Using multivariate Johansen's co-integration (Johansen, 1991) and Granger causality (Granger, 1969), it was found that the selected macro-economic variables did have a relationships with stock returns. Despite this, the macro-economic variables did not significantly influence the returns on the stock market.

It is evident from the studies reviewed that despite the evidence of relationships between macro-economic variables and stock returns, predictability within the South African economy also shows mixed results. There is some consistency between the result of studies using variables such as interest rates and exchange rates (Chen et al., 1986, Chinzara, 2011, Ekundayo, 2015, Hsing, 2011, Jareño, 2016, Jefferis & Okeahalam 2000, Peiró, 2015, Modise and Gupta, 2011, Ouma & Muriu, 2014, Tripathi, 2014, Trivedi & Behera, 2012), however the results using other variables are less consistent. This current study will explore these relationships further, providing evidence on more recent data to add value and insight into past studies' results. This study will also consider how relationships differ over differing time periods and will consider the impact of the recent financial crisis in 2008 by the inclusion of a structural break. Additionally, the study will make use of both monthly and quarterly

data to consider whether the use of more frequent data plays a role in the relationships observed.

LINKING SOUTH AFRICA TO OTHER MARKETS

Global markets do not operate in isolation and with the growing speed of globalisation, it is important to consider the impact market factors around the world have on each other. These relationships between different economies are important for an investor to understand when making investment decisions. Specifically, the impact of the US stock market and economy on other countries' stock market returns has been widely investigated (Ahmed, Coulibaly & Zlate, 2015; Chinzara & Aziakpono, 2009; Jefferis & Okeahalam, 2000; Samarakoon, 2011). Rapach *et al.* (2013) investigated the lead and lag relationships between specific countries' stock returns and returns in the United States' stock market. The results showed that US returns predicted returns over specific periods for several countries, namely Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland and the United Kingdom.

Mensi *et al.* (2014) examined the dependence structure between emerging markets and influential global economic factors using daily data of BRICS countries and global economic factors over the period between September 1997 and September 2013. The BRICS countries were chosen because they are significant recipients of global investment flows and are among the highest consumers of global commodities (Prasad *et al.*, 2003), thus a relationship between these economies and global economic factors may exist. Using a quantile regression approach, this relationship was found. Specifically, Mensi *et al.* (2014) uncovered a positive and significant dependence between the returns on the global stock market (using the S&P index as a proxy) and the stock market returns in the BRICS countries, both before and after the global financial crisis in 2008. However, the BRICS stock markets only moved with the global stock market when the market was bullish, but independently when bearish.

Sousa *et al.* (2016) also studied the impact of the United States stock market on BRICS countries. Sousa *et al.* (2016) examined the predictive ability of macro-economic, macro-financial and US/Global variables for stock returns in BRICS countries. The macro-economic variables examined included inflation, interest rates, the output gap

as a percentage of GDP, money supply, change in the commodity price index and the dollar exchange rate. These variables were all tested for predictive power using quarterly data covering 1995 to 2013. The outcome of the study concluded that the macro-economic variables analysed had very little predictive power.

Chinzara and Azziakpono (2009) analysed the returns and volatility linkages between the South African stock market and the leading world equity markets. It was found that there were both returns and volatility links between South Africa and the Australian, Chinese and North American stock markets, with these three markets having the highest degree of influence over the South African stock market's returns and volatility.

The above studies show that there is evidence of some impact of global markets on the returns in the South African market (Chinzara, 2011; Hsing, 2011). This relationship will be further explored in this current study through the inclusion of proxies for both macro-economic activity and stock market returns in international markets.

It is evident from the above literature that there are economic and financial theories to support relationships between stock returns and macro-economic variables. These relationships have been examined in both developed and developing markets. There are conflicting results with regard to the evidence of predictability in markets around the world. This study will attempt to bring clarity by exploring the relationship between SA macro-economic variables, international macro-economic variables and returns on the South African market using a more recent dataset.

RESEARCH METHODOLOGY

The literature reviewed suggests that there is limited consensus as to whether macro-economic variables are predictors of stock market returns. This lack of consensus was evident in literature relating to both a developed and developing market context, specifically South Africa. The objective of this study is to examine whether the selected macro-economic factors can be classified as predictors of returns on the JSE (Johannesburg Stock Exchange).

This study aims to add to the above body of literature and provide clarity to the mixed findings by increasing the scope of testing (using both monthly and quarterly data, including both local and international macro-economic variables as well as a structural break in the testing conducted). The research questions this study aims to answer are as follows:

1. Are selected South African macro-economic variables predictors of the JSE All Share Index?
2. Are selected international macro-economic variables predictors of the JSE All Share Index?
3. Are the selected macro-economic variables predictors of the JSE All Share Index both before and after the 2008 financial crisis period?

To answer these research questions an OLS (Ordinary Least Squares) regression analysis will be used. This chapter will continue with a description of the data collected, the variables chosen and the mode of testing employed.

RESEARCH DATA

This study will cover the period June 1995 – December 2016 (“the period”). This period was selected because it was the largest set found to be available, covering all variables chosen. A period of this length (i.e. one spanning 20 years) allows for the examination of the relationship between macro-economic variables and the stock market over time. The period includes data relating to the financial crisis which took place in 2008 (Ikoku & Okany, 2014). Therefore, this study examines the relationship between the macro-

economic variables and the stock market both prior to the financial crisis and post the financial crisis. This analysis will be conducted via the inclusion of a structural break, which is discussed later in this chapter.

Both monthly data and quarterly data were gathered. The use of monthly data equates to 258 data points over the period tested, allowing for robust statistical testing. However, the variables 'South African Gross Domestic Product' and 'United States Gross Domestic Product' were not available monthly, only quarterly. Therefore, testing was also performed on a quarterly basis, for which 87 data points were available. Furthermore, the testing of both monthly and quarterly data sets will allow for the assessment of whether the change in the frequency of data impacts the predictive relationship of the variables tested, which represents an inclusion unique to this study.

Data was collected from StatsSA, the South African Reserve Bank (SARB) databases and from I-net. StatsSA may be considered a credible source because it is the National Statistical Service of South Africa, producing regular statistics to aid further economic research and development (Statistics South Africa, 2017). The SARB is the National Reserve Bank, producing regular economic statistics to inform the market of the relative financial stability of the economy (South African Reserve Bank, 2017). I-net is a leading provider of financial and economic data (I-net, 2017).

VARIABLES TESTED

In this study, the dependent variable will be the Johannesburg All Share Index (representing the South African stock market) and the independent variables will be the selected local and international macro-economic variables, as identified in the literature review. Both South African and international macro-economic variables were used to assess the relative predictive power.

DEPENDENT VARIABLE

The dependent variable is the South African stock market. The Johannesburg Stock Exchange All Share (JSE All Share Index) was chosen as a proxy for the South African stock market. This index may be considered a proxy for the market because it is representative of the largest and longest standing stock exchange in the South African market (Johannesburg Stock Exchange, 2017). The index is capitalization weighted

and as a result represents up to 99% of the market value of all ordinary shares listed on the main board of the exchange (Johannesburg Stock Exchange, 2017).

INDEPENDENT VARIABLES

Within this study both South African and international macro-economic variables have been chosen. The international variables are limited to macro-economic variables in the United States. The United States was chosen to assess whether movements of this leading economy have an impact on movements in the South African stock market. The United States economy is considered to play a leading role in movements in global stock markets (Wen *et al.* 2015), thus the inclusion of variables relating to this economy may be considered a measure of the impact of the global economy on the South African stock market.

It is expected that the same hypothesised relationship will exist between the South African macro-economic variables and the dependent variable, and the international macro-economic variables and the dependent variable. The direction of the hypothesised relationship is expected to be the same due to potential contagion between the markets (Chinzara *et al.*, 2009). The direction of movement that selected international macro-economic factors have in their own economy is hypothesised to impact the South African stock market due to potential linkages between the economies as a result of globalisation (Bekiros, 2014). While the direction of impact is expected to remain the same, the size of the impact is likely to differ given that the macro-economic activity is not occurring within the local economy.

The following independent variables were selected, namely: 1) GDP (SA and US), 2) Interest Rates (SA and US), 3) Inflation (SA and US), 4) South African Money Supply, 5) Rand/Dollar Exchange Rate, and 6) FTSE Index. A discussion of each independent variable and its hypothesised relationship with the dependent variable follows.

GROSS DOMESTIC PRODUCT

The level of South African real economic activity is measured using Gross Domestic Product (GDP). GDP is often used as a measure of economic growth within an economy (Pradhan, Arvin & Ghoshray, 2015). GDP is representative of the monetary value of all goods and services produced over a specific time period and indicates the

level of real output within an economy (Hsing, 2011). If GDP is experiencing growth, it is expected that businesses operating within the economy would similarly experience growth in earnings. This growth in earnings consequentially should be reflected in the stock prices because stock prices are reflective of the discounted future cash flows expected to flow to the business (Chen *et al.*, 1986).

This variable has been used as a proxy for real economic activity in prior literature (Hsing, 2011; Macfarlane & West, 2011; Ouma & Muriu, 2014; Sousa *et al.*, 2016; Tripathi & Seth, 2014; Trivedi & Behera, 2012). Similarly, United States real economic activity is represented by the United States GDP. This factor has also been used in literature as a proxy for the level of real economic activity occurring in the US market (Hsing, 2016; Talla, 2013).

Real economic activity has long been considered a driver of stock market returns (Fama, 1981). Fama (1990) theorised that the relationship between current stock returns and future production levels provided information about future cash flows for an investor. This relationship was further confirmed by Schwert (1990) who performed similar testing on an increased sample size in the United States. Drawing on both studies there appears to be value creation opportunities in utilising economic growth data when analysing stock returns.

It is hypothesised that there will be a positive relationship between South African GDP and the dependent variable (i.e. the JSE All share). An increase in economic output and activity within an economy is likely to result in future expected cash flows for a company due to the relative increase in activity within the economy it operates in (Macfarlane & West, 2011). Thus, as real economic activity increases a positive movement is expected to occur in the stock market.

United States GDP is also hypothesised to have a positive relationship with the South Africans stock market. As United States GDP rises, it indicates increased economic activity because it is a measure of real activity. This increased economic activity has been suggested to drive up surplus disposable income and results in increased positivity in relation to investor sentiment (Haq & Larsson, 2016). This positive investor sentiment is likely to lead to increased international investment, which may potentially

drive stock prices higher in the South African markets (due to increased demand for South African stocks).

INTEREST RATES

The prime lending rate is used as a measure of South African interest rates. This rate is used by commercial banks as a basis for determining lending rates for customers, adding on a premium for factors such as customer credit-worthiness and the banks' own risk appetite (South African Reserve Bank, 2009). The prime interest rate underpins borrowings from commercial banks within a market and is considered to be playing the role of a market reference rate (South African Reserve Bank, 2009).

The prime lending rate differs from the prime repurchase rate (commonly referred to as the repo rate) which represents the rate at which the South African Reserve Bank lends to commercial banks (South African Reserve Bank, 2017). The prime rate was selected in this study in preference to the prime repurchase rate. As the prime lending rate is referred to as the 'market reference rate' (South African Reserve Bank, 2009) it is likely to be closer to the rate that affects the majority of market participants, which consequentially should be the rate that may impact movements on the stock market.

Following this same reasoning, the US interest rate is proxied by the prime lending rate. As defined by the Federal Reserve Bank, the prime rate is the rate at which commercial banks provide loans to preferred borrowers (US Government, 2013), which effectively follows the same definition as the prime interest rates within South Africa

Interest rates play a role in stock pricing because they directly impact the discount rates applicable in stock price valuation models (Macfarlane & West, 2011). The interest rate often represents the risk-free return investors could earn elsewhere in the market. Therefore, a shift in the interest rate, will result in a shift in the type of assets investors choose to invest in. Consequentially, changes in interest rates bring about changes in stock market demand, which affects asset prices. This fact is conferred by Mukherjee and Naka (1995) who hypothesised that changes in both the short-and long-term bond rates affect the discount rate via a positive relationship with the risk-free rate.

A rising interest rate is likely to result in falling stock prices. This decrease is expected to occur due to higher interest rates increasing the opportunity cost of holding money, consequentially, causing a substitution effect of stocks for interest-bearing securities (Jefferis & Okeahalam, 2000). Interest rates (both in South Africa and the United States) are hypothesised, therefore, to have a negative relationship with the dependent variable.

RAND/DOLLAR EXCHANGE RATE

The Rand/Dollar exchange rate represents the units of South African Rands that are required to purchase a Dollar. When the Rand appreciates against the Dollar, this movement has been found to impact economic activity in the following manner: the level of imports into the market are increased due to imports becoming relatively cheaper, exports are decreased because they are more expensive post the appreciation in the currency, and the domestic value of international investments is reduced because they are worth less in Rand terms after the appreciation (Hsing, 2016). Therefore, it is hypothesised that there will be a negative relationship between the Rand/Dollar exchange rate and the JSE All Share Index.

SOUTH AFRICAN MONEY SUPPLY

Money supply is the amount of money (notes and coins) that is in circulation within an economy. Money supply within this study will be represented by M0.² This symbol has been used as a proxy for money supply in prior literature (Talla, 2013). M0 represents the form of money supply that can be defined as the non-banking sector holdings of notes and coins (Talla, 2013). Therefore, consisting of all notes and coins that are in circulation and excluding notes and coins held by commercial banks. This determination is relevant to the study, because it represents the money that flows freely within the market and, thus, is theorised to be closely linked to movements in the market.

² There are five different forms of money supply, namely M0, M1, M2, M3 and M4 (Kock & Brink, 2009)

An increase in money supply is hypothesised to positively affect stock prices: when monetary policy is expansionary, the economy is positively stimulated (Talla, 2013). Consequentially, companies within the economy experience increased cash flows which has a positive impact on its respective stock prices (Rogalski *et al.*, 1977). In addition to the effect on a company's expected cash flow, consumers are likely to have increased disposable income which may result in an increase in the demand for stocks, ultimately increasing the level of stock prices (Trivedi & Behera, 2012).

Despite the results of the above studies there has been evidence indicating limited consensus concerning the direction of the relationship between the stock market and money supply Humpe and Macmillan (2009) found a negative relationship between money supply and the stock market while a positive relationship was found by Hsing (2011). Adding to these differing results Mukherjee and Naka (1995) found a positive relationship between the stock market and money supply.

Given the above differing results and the economic theory discussed, it is hypothesised that money supply will have a positive relationship with stock prices.

INFLATION

South African inflation is represented by the Consumer Price Index (CPI). This index is frequently used in literature as a proxy for inflation (Chinzara, 2011; Gay, 2008; Jareño, 2016; Macfarlane & West, 2011). Similarly, the US Consumer Price Index is used as a proxy for US inflation. The South African CPI, like the US CPI, is a measure of prices paid by consumers for a representative basket of goods (Federal Reserve Bank, 2016). Changes in inflation indicates the existence of inflation which, in turn, has an impact on the economy and, consequentially, the stock market.

South African inflation is hypothesised to have a negative relationship with the JSE All Share Index. When an economy is experiencing inflation, it often coincides with the tightening of monetary policies (Hamzah, Maysami & Howe, 2004). Tightening monetary policies often results in lower money supply within an economy, effectively resulting in lower disposable income for consumers and, consequentially, lower expected cash flows for companies. Thus, rising domestic inflation is expected to drive stock prices downwards (Shawtari *et al.*, 2016).

As with South African inflation, it is expected that there will be a negative relationship between US Inflation and the United States stock market. The economic theory (Fama, 1982; Fisher, 1930) underpinning the hypothesised relationship in the South African market is expected to hold in the United States market. In addition to this it is hypothesised that the United States inflation rate will also have a negative relationship with the South African stock market.

FTSE ALL SHARE INDEX

This is a capitalisation weighted index that comprises all listed companies on the London Stock Exchange (London Stock Exchange, 2016). This exchange was included in the analysis due to the prevalence of South African companies that have listed on the London Stock Exchange or may be affected by movements in international stock markets.

Many South African based companies have chosen to have dual listings in an effort to increase shareholder value and access to international sources of finance (Carmody, 2002). Thus, the inclusion of this index will enable the researcher to explore how movements in this stock market impact movements in the South Africa stock market. Due to the overlap in listing (i.e. the increasing number of dual listings) it is likely that the relationship between these markets is positive. It is hypothesised, therefore, that a positive relationship will exist.

Furthermore, 43% of the JSE All Share Index as at 31 October 2017 (FTSE Russell, 2017) consisted of the top five constituents, namely; Naspers, Compagnie Financiere Richemont AG (Richemont), BHP Billiton, Anglo American and British American Tobacco. These companies hold dual listings, i.e. all the above companies, barring Richemont, are listed on the London stock exchange, hence the selection of this index in this study. The dual-listing results in the value of these stocks being exposed to events occurring in international markets. Therefore, it is important to consider potential impactors on the stock prices of these companies, such as international profits from international operations which, in turn, may affect the dependent variable due to their relative weighting in the Index.

Table 1 of Appendix A summarises the variables that will be used in this study. It details the source of the data and provides respective variable names to be used in the Results Chapter.

RESEARCH PROCESS

To assess whether the independent variables (the macro-economic factors) can be considered predictors of the dependent variable (the All Share Index) this study will utilise time series OLS regression analysis (Mavee & Perrelli, 2016, Rapach *et al.*, 2013). When including the variables in the regression analysis they will be subject to a logarithmic transformation. The use of logs reduces the magnitude of data, and allows for the ease of interpretation of the data (Haq & Larsson, 2016). Logs are also utilised within the study in an attempt to control for heteroscedasticity (Li, Balcilar, Gupta, & Chang, 2015). Natural logs are widely used when dealing with econometric data (Haq & Larsson, 2016; Hsing, 2011; Li *et al.*, 2015; Macfarlane & West, 2011; Ouma & Muriu, 2014; Talla, 2013) and, thus, will be used in this study. It was noted that there was no need to log interest rates or inflation due to these factors already being in percentage form (Haq & Larsson, 2016; Hsing, 2011).

The predictive ability of time-series data using OLS regression analysis is dependent on the data exhibiting stationarity (Ouma *et al.*, 2014). If the time series data exhibits non-stationarity trends it may lead to spurious regression results, obscuring the interpretation of any predictive relationship results. Time-series data will be classified as stationary if it has a stationary trend (Kwiatkowski, Phillips, Schmidt, & Shin, 1992). A stationary trend indicates that the time series data has a constant mean, variance and autocorrelation over time (Shawtari *et al.*, 2016). If these properties do not exist within a set of time-series data, the data cannot be modelled or forecasted because the results using non-stationary data may indicate relationships that may not exist (Ouma *et al.*, 2014). To avoid this, the Augmented Dickey-Fuller (ADF) test (Dickey, Hasza & Fuller, 1984) will be used to evaluate whether the time series data is stationary or not. If a variable does not exhibit stationarity it will be subject to differencing until the variable passes the unit root test. A more detailed discussion of this test is provided in Appendix B.

An Ordinary Least Squares (OLS) regression will be used to identify the existence and predicative ability of relationships between the independent variables and the dependent variable. An OLS regression utilises the least squares to estimate the coefficient of the regression. This method results in an estimated coefficient that will be the same as the true value of the variable on average, with the least amount of error (Ouma & Muriu, 2014). This estimation is of importance when using regression analysis to analyse predictive relationships.

The regressions will be run with the dependent variable being the All Share Index. In the first instance, an individual regression will be run for each independent variable to examine its relationship with the dependent variable. Then, two further regressions will be run, one with only the South African independent variables and another including both South African and US independent variables. A regression including only South African variables is conducted to answer the first research question and assess whether the stock market is impacted by South African variables, before control variables are included to control for international factors. The second research question will be answered when these international variables are included in the second set of regressions.

To answer the third research question of this study, a structural break will be included in the data to separate the 2008 financial crisis period. This will result in a regression being run over the data before the period and a second regression being run over the data points occurring after the financial crisis period, resulting in the exclusion of data points during the financial crisis period.

To determine the period of the financial crisis, the JSE All Share Index data was graphically plotted against time. An increase in the volatility of movements in the All Share Index between the middle of 2007 and the middle of 2009 was noted. This is depicted in Figure 1 in Appendix C which highlights the period of volatility by graphing the movement of the JSE All Share Index over the period examined (i.e. 1995 - 2016). The period of the crisis was identified by Willows and West (2015) as May 2008 to February 2009. In this study, the crisis period was extended a year ahead of this to account for the appearance of volatility movements in the data leading up to the above

identified period. This volatility may skew the results and thus a prudent approach was followed in the exclusion of the additional year. Thus, the structural break will be included over the period from May 2007 up to and including February 2009. Due to the nature of time series data a separate regression was run over the pre-financial crisis data and the post-financial crisis data. The structural break will only be included for tests run over the monthly data, owing to a lack of sufficient quarterly data points in both the pre-and post-crisis period quarterly data sets.

EMPIRICAL RESULTS

This chapter will begin by presenting the results of the stationarity test. Next the results of the regression analyses will be provided, which will include discussions on both the quarterly and monthly results, and the structural breaks.

STATIONARITY TEST

The ADF unit test was run over the selected variables. Two tests were run for each variable, each with a different lag, namely the maximum lag and the sequential t-lag length (see Appendix B for details relating to the ADF test). If a variable did not pass the stationarity test (on both lag levels) it was deemed non-stationary and was differenced³. The test was then re-run over the differenced variable and the process repeated until stationarity was achieved.

Before running the ADF test, each variable's data points were plotted against time. This process was undertaken to determine whether the null hypothesis should include a drift term⁴ or whether the regression used to find the test statistic includes a constant term to account for the time trend⁵ (Talla, 2013). All variables were stationary at either the first or second difference, after rejecting the assumption of non-stationarity at the

³The first difference of a time series is the series of changes from one period to the next. To find a difference for a data set one needs to compute the difference between consecutive variables. This process attempts to eliminate trends and seasonality in time series data (Penn State World Campus, 2013).

⁴A drift term is included in the ADF test when a scatter plot of the data associated with the tested variable is indicative of following a random walk with no drift term (Stata Handbook, 2013).

⁵ The time trend is included in the ADF test when the scatter plot of the data relating to the variable tested for stationarity indicates a strong trend (Stata Handbook, 2013).

5% level for both lag levels. These variables, consequentially, were included in the relevant regressions.

DESCRIPTIVE STATISTICS

Table 1 below presents the descriptive statistics for each of the variables used in the testing performed. It depicts the number of observations, the mean value, the standard deviation and the minimum and maximum values for each variable. The labels relating to these variables can be found Table 6 in Appendix A. These values are presented for the data relating to the variable used in the monthly, quarterly, pre-crisis and post-crisis periods. These values appear small due to the logging and subsequent differencing of variables because of the stationarity testing. This transformation process will be accounted for in the interpretation of the results relating to these variables.

Table 1

Variable		Monthly	Quarterly	Pre-Crisis	Post-Crisis
Log_ALSI_qp	N	257	85	141	94
	Mean	0.009	-0.001	0.012	0.010
	Std. Dev	0.045	0.119	0.050	0.028
	Min	-0.198	-0.317	-0.198	-0.065
	Max	0.121	0.403	0.121	0.070
	Log_SAGDP	N		85	
Mean			0.000		
Std. Dev			0.006		
Min			-0.017		
Max			0.012		
Log_USGDP		N		85	
	Mean		0.000		
	Std. Dev		0.008		
	Min		-0.024		
	Max		0.037		
	SAInt	N	257	86	141
Mean		-0.021	-0.036	-0.021	-0.007
Std. Dev		0.577	1.101	0.646	0.372
Min		-1.510	-2.640	-1.460	-1.510
Max		3.490	4.650	3.490	1.070
USInt		N	257	85	141
	Mean	-0.020	0.005	-0.004	0.004
	Std. Dev	0.158	0.401	0.168	0.023
	Min	-0.980	-1.390	-0.750	0.000
	Max	0.260	1.350	0.260	0.140
	SAInfl	N	257	86	141
Mean		-0.009	-0.037	-0.014	-0.018
Std. Dev		0.619	1.482	0.719	0.360
Min		-2.400	-5.400	-2.400	-1.100
Max		1.800	3.900	1.800	1.000
USInfl		N	257	85	141
	Mean	0.351	-0.004	0.378	0.326

	Std. Dev	0.577	1.295	0.448	0.471
	Min	-3.842	-3.900	-1.000	-1.377
	Max	2.700	5.060	2.700	1.768
Log_M0					
	N	257	85	141	94
	Mean	0.009	0.000	0.011	0.008
	Std. Dev	0.036	0.084	0.042	0.027
	Min	-0.174	-0.280	-0.174	-0.084
	Max	0.115	0.124	0.115	0.077
Log_RD					
	N	257	85	141	94
	Mean	0.005	0.000	0.005	0.003
	Std. Dev	0.037	0.100	0.037	0.032
	Min	-0.103	-0.296	-0.088	-0.103
	Max	0.184	0.223	0.172	0.093
Log_FTSE					
	N	256	85	140	94
	Mean	0.000	-0.001	0.000	0.000
	Std. Dev	0.077	0.126	0.003	0.002
	Min	-0.271	-0.429	-0.012	-0.009
	Max	0.312	0.520	0.008	0.008

REGRESSION RESULTS

OLS regressions were performed over the various sets of data (monthly, quarterly, pre-crisis and post-crisis). The regression model implies that the predicted values of the stock market are caused by the predicted values of the macro-economic variables. Namely, a percentage change in Y (the stock market) is caused by a percentage change in X (the selected macro-economic variable). This observation is made due to either the percentage form of the variable (interest rates and inflation rates) or the log transformed variable being included (Talla, 2013).

To assess the significance of the relationships between selected macro-economic variables and the South African stock market, a test statistic is calculated. The P-value of this test statistic is compared to the relevant critical value and the significance of the relationship is assessed. When assessing whether a model is well fitted, the F-test is utilised in addition to R^2 . R^2 measures the strength of the relationship between the South African stock market and the selected macro-economic variables, by presenting the percentage of variance explained by the selected macro-economic

variables. R^2 differs from the F-test which measures whether the relationship is statistically significant (Wooldridge, 2006). This R^2 test allows for the assessment of whether the fitted model is statistically significantly different from a model with no predictor variables. To account for potential heteroscedasticity, both the Breusch and Pagan (1979) and the White (1980) tests were performed. Where heteroscedasticity was present in the relevant regressions, robust standard errors were used in the tests.

INDIVIDUAL REGRESSION RESULTS

A single regression was run separately with each independent variable. The individual regressions indicate whether selected macro-economic variables hold a significant relationship with the dependent variable (i.e. the South African stock market) and indicates the direction of the relationship. The formulae for these regressions are as follows:

$$JSE\ ALSI = \beta_0 + \beta_1 SA\ GDP + \mu \quad \text{Table 2(A)}$$

$$JSE\ ALSI = \beta_0 + \beta_1 US\ GDP + \mu \quad \text{Table 2(B)}$$

$$JSE\ ALSI = \beta_0 + \beta_1 SA\ Interest\ rate + \mu \quad \text{Table 2(C)}$$

$$JSE\ ALSI = \beta_0 + \beta_1 US\ Interest\ rate + \mu \quad \text{Table 2(D)}$$

$$JSE\ ALSI = \beta_0 + \beta_1 SA\ Inflation\ rate + \mu \quad \text{Table 2(E)}$$

$$JSE\ ALSI = \beta_0 + \beta_1 US\ Inflation\ rate + \mu \quad \text{Table 2(F)}$$

$$JSE\ ALSI = \beta_0 + \beta_1 SA\ Money\ Supply + \mu \quad \text{Table 2(G)}$$

$$JSE\ ALSI = \beta_0 + \beta_1 Rand\ /Dollar\ Exchange\ rate + \mu \quad \text{Table 2(H)}$$

$$JSE\ ALSI = \beta_0 + \beta_1 FTSE + \mu \quad \text{Table 2(I)}$$

In the regression formulas β_0 represents the constant, while β_1 represents the coefficients of the selected macro-economic variables tested, and μ refers to factors not identified or included in the model and, therefore, not controlled for (Talla, 2013).

The ability of the variables to be used as predictors is determined by the significance of its p-value output in each regression.

Each regression is performed twice. In the first instance, monthly data is used, and in the second instance, quarterly data. As a result, the South African Gross Domestic Product and United States Gross Domestic Product variables are only included in the second regression ⁶. Table 2 presents the coefficients of the independent variables with its standard error term. Additionally, the constant and its standard error are presented. The number of observations in each regression (N) is also shown.

Table 2

Formula	Variables	Test 1: Monthly data		Test 2: Quarterly data	
		Coef.	Constant	Coef.	Constant
A	Log_SAGDP (N = 85)			1.67	-0.001
				<i>-2.351</i>	<i>-0.013</i>
B	Log_USGDP (N = 85)			-0.451	-0.001
				<i>-1.594</i>	<i>-0.013</i>
C	SAInt (N = 257; 85)	-0.013***	0.009***	-0.035**	-0.004
		<i>-0.005</i>	<i>-0.003</i>	<i>-0.017</i>	<i>-0.012</i>
D	USInt (N = 257; 85)	-0.005	0.009***	-0.077**	-0.001
		<i>-0.022</i>	<i>-0.003</i>	<i>-0.031</i>	<i>-0.013</i>
E	SAInfl (N = 257; 85)	-0.005	0.009***	-0.011	-0.001
		<i>-0.006</i>	<i>-0.003</i>	<i>-0.009</i>	<i>-0.013</i>
F	USInfl (N = 257; 85)	0.011**	0.005*	0.006	-0.001
		<i>-0.005</i>	<i>-0.003</i>	<i>-0.010</i>	<i>-0.013</i>
G	Log_M0 (N = 257; 85)	-0.125	0.010***	0.094	-0.001
		<i>-0.078</i>	<i>-0.003</i>	<i>-0.155</i>	<i>-0.013</i>
H	Log_R\D (N = 257; 85)	-0.223*	0.010***	-0.213*	-0.001
		<i>-0.130</i>	<i>-0.003</i>	<i>-0.128</i>	<i>-0.013</i>
I	Log_FTSE (N = 257; 85)	0.273***	0.009***	0.460	-0.001
		<i>-0.042</i>	<i>-0.002</i>	<i>-0.960</i>	<i>-0.013</i>

Standard errors in italics

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The regression results indicate statistically significant negative relationships with the South African interest rate across both tests, at the 1% level for Test 1 and the 5%

⁶ Monthly data is not available for the variables: 'South African Gross Domestic Product' and 'United States Gross Domestic Product'.

level for Test 2. This result is similar to Jefferis and Okeahalam (2000) who found South African interest rates to hold the most significant relationship with the South African stock market. The relationship with interest rates has also been confirmed in a European context (Peiró, 2015), indicating that, despite differences in economic development, the predictive relationship with this variable and the stock market is consistent across differing economies.

Furthermore, the US interest rate variable is also statistically significantly, but only in Test 2 in which quarterly data was used. Interest rates are considered to be closely linked via the role they play in monetary policy (Macfarlane & West, 2011). They play a role in the cost of capital both for the investor and the company with listed shares. Thus, as interest rates rise, it is likely that they will impact on the demand for stocks. This result occurs due to decreased demand for stocks as the opportunity cost of investing rises when interest rates increase. Rising interest rates have an additional effect on company profits. Company profits decrease due to increased interest payments on debt. These changes in stock prices and company profits may be the cause of the observed relationship because of their negative impact stock prices (Chinzara, 2011).

Similar to the study conducted by Jefferis and Okeahalam (2000) the Rand/Dollar exchange rate was found to hold a statistically significant negative relationship with the stock market at the 10% level across both tests. The significance of the negative relationship with exchange rate indicates that the South African economic balance of trade may be more heavily weighted towards imports. If trade balance is more heavily weighted towards imports the balance is sensitive to appreciations or depreciations of the Rand/Dollar exchange rate. This is due to the mechanisms of supply and demand. If the Rand/Dollar rate depreciates, the demand for the Rand increases, due to the relative price of products (Hamzah *et al.*, 2004). From the observed significant relationship, this flow of currency appears to impact the demand for stocks in the SA stock market.

The United States Inflation rate and the FTSE Index were found to have a statistically significant positive relationship in Test 1 only, where monthly data was utilised. It

appears that the increase in frequency of data caused a strengthening of the relationship between these independent variables and the stock market. As the FTSE Index is subject to constant movement, it is likely that the use of quarterly data may have resulted in other market noise which might reduce the significance of this variable's relationship with the stock market. The existence of a relationship with the FTSE Index indicates possible linkages between these two differing stock markets (Bonga-Bonga & Makakaule, 2010) which will be further explored in the testing to follow.

Despite other variables not appearing to have significant relationships with the stock market, an analysis of the coefficients of the regressions took place to assess the direction of their relationship with the dependent variable. Table 3 presents the selected macro-economic variables and their relationship with the South African stock market. The second column presents the hypothesised relationship as discussed in the independent variables section of the research methodology. The last two columns present the observed relationships in the monthly and quarterly regression outputs from Table 3.

Table 3

Variable	Hypothesised Direction	Monthly	Quarterly
Log_SAGDP	Positive	0	Positive
Log_USGDP	Positive	0	Negative
SAInt	Negative	Negative	Negative
USInt	Negative	Negative	Negative
SAInfl	Negative	Negative	Negative
USInfl	Negative	Positive	Positive
Log_M0	Positive	Negative	Positive
Log_R\ID	Negative	Negative	Negative
Log_FTSE	Positive	Positive	Positive

The hypothesised direction of relationships was confirmed for all variables except for US GDP, US Inflation and South African Money supply.

The observed relationship with US GDP was negative despite the hypothesised outcome and the SA GDP variable showing a positive relationship. This fact suggests

that when the US economy is experiencing economic growth, the investment overflow of this growth is not significant enough to affect the South African stock market positively (Haq & Larsson, 2016). The negative relationship possibly indicates that investors who invest internationally may shift investment flows from the United States to other markets. This investment shift may occur when the US economy is experiencing negative economic growth and, consequentially, the South African stock market may be positively impacted by increased demand for stocks (Alfaro, Chanda, Kalemli-Ozcan & Sayek, 2004).

The observed relationship with US Inflation was positive despite the hypothesised outcome and the SA Inflation variable showing a negative relationship. It is proposed that, due to the assumption that stock is shielded from inflation (Fisher, 1930), there could be a positive relationship between inflation and stock prices. Rising inflation would direct investor investment flows into stocks, boosting demand for stocks and, hence, the prices of those stocks. This assumption appears to hold for international inflation but not for local inflation. Rising inflation in the United States is observed to have a positive impact on the South African stock market. Furthermore, the direction of this relationship may be due to increasing local economic uncertainty in the US when there is rising inflation. This uncertainty may result in increased international investment. Alternatively, rising US inflation may result in increased import substitution (Vernon, 1966) with South African products, thus boosting stock prices via the effect of increased company cash flow. This situation differs from the relationship experienced between South African inflation and the stock market. This observed and hypothesised negative relationship indicates that the inflationary impact on company profits outweighs the shift in demand for stock during inflationary periods.

The relationship with SA money supply appears to have changed in response to a change in data frequency. The observed relationship in Test 2 was positive (in alignment with the hypothesised relationship). However, the observed relationship in Test 1, in which monthly data was used, was negative. This may be a result of the timing during which changes in the money supply are assimilated into the market. Given there is limited consensus over what direction money supply generally holds in relation to the stock market (Hsing, 2011; Humpe & Macmillan, 2009; Hsing 2011;

Mukherjee & Naka, 1995) it is possible that the timing of information release and assimilation into the stock market may have a significant impact on the direction of the relationship.

MULTIVARIATE REGRESSION RESULTS

Table 4 presents the results for the multivariate regression analysis. The results of two tests, with the first test having two stages of testing, are shown. For the first test only, South African independent variables are included. This limitation is implemented to assess the predictive ability of macro-economic variables in the local economy only. The testing including only South African variables allows for the assessment of the strength of the relationship between variables in the local economy and the local stock market, before external international factors are controlled for. This process enables comparison between the strength of relationships of the local variables and the stock market and the strength of the relationships between the local variables and the stock market, when international variables are included for in the regression. The two stages of testing in the first test represents the separate testing on monthly and quarterly data. In the second test, the South African variables are further supplemented with the US independent variables. The inclusion of US independent variables allows for the assessment of the level to which the South African stock market movements may be linked to movements in exogenous factors, such as international markets. The inclusion of international variables allows the assessment of whether the model's predictive ability has improved. An improvement in the strength and existence of relationships will indicate the South African market is significantly impacted by international factors. The second test is only performed on monthly data, owing to a lack of sufficient quarterly data, which would compromise the robustness of the OLS regression (Wooldridge, 2006). The formulae for the tests in Table 4 are as follows:

$$JSE\ ALSI = \beta_0 + \beta_2 SA\ interest\ rate + \beta_3 Rand\ Dollar\ exchange\ rate \\ + \beta_4 SA\ inflation\ rate + \beta_5 SA\ Money\ Supply + \mu$$

Table 4: Test 1 – Stage 1

$$JSE\ ALSI = \beta_0 + \beta_1 SA\ GDP + \beta_2 SA\ interest\ rate + \beta_3 Rand\ Dollar\ exchange\ rate \\ + \beta_4 SA\ inflation\ rate + \beta_5 SA\ Money\ Supply + \mu$$

Table 4: Test 1 – Stage 2

$$\begin{aligned}
JSE\ ALSI = & \beta_0 + \beta_1 SA\ interest\ rate + \beta_2 Rand\ Dollar\ exchange\ rate \\
& + \beta_3 SA\ inflation\ rate + \beta_4 SA\ Money\ Supply + \beta_5 US\ interest\ rates \\
& + \beta_6 Us\ inflation\ rate + \beta_7 US\ industrial\ Production + \beta_8 FTSE + \mu
\end{aligned}$$

Table 4: Test 2

In the regression formulas β_0 represents the constant, while β_1 represents the coefficients of the selected macro-economic variables tested, and μ refers to factors not identified or included in the model and, therefore, not controlled for (Talla, 2013).

Table 4

Variables	Test 1: Local variables only		Test 2: All variables
	Stage 1: Monthly data	Stage 2: Quarterly data	Monthly data
Log_SAGDP		1.540 -2.271	
SAInt	-0.016** <i>-0.006</i>	-0.037*** <i>-0.013</i>	-0.016*** <i>-0.006</i>
Log_R\ID	-0.174 <i>-0.137</i>	-0.186 <i>-0.125</i>	-0.087 <i>-0.115</i>
Log_M0	-0.117 <i>-0.076</i>	0.070 <i>-0.148</i>	-0.025 <i>-0.072</i>
SAInfl	-0.011 <i>-0.007</i>	-0.017* <i>-0.009</i>	-0.009 <i>-0.006</i>
USInt			-0.002 <i>-0.019</i>
USInfl			0.006 <i>-0.005</i>
Log_FTSE			0.257*** <i>-0.041</i>
Constant	0.011*** <i>-0.003</i>	-0.004 <i>-0.012</i>	0.007** <i>-0.003</i>
Observations	257	85	256
F (4, 252), (5, 79)	3.190	2.840	12.290
Prob > F	0.014	0.021	0.000
Root MSE	0.081	0.113	0.039
R ²	0.081	0.179	0.275

Standard errors in italics

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Noted in each multivariate regression is an R^2 below 1, indicating a potential lack of goodness of fit. The low R^2 indicates that there are several factors affecting the South African stock market that have remained unaccounted for within the model. However, this deficiency does not necessarily imply that these unaccounted for factors are correlated with the stock market (Wooldridge, 2006). As the regressions displayed a small R^2 , it was necessary for an additional post estimation tool to be considered, namely the F-Test. All three tests have a statistically significant F-test statistic (at the 5% level). This result indicates that the group of variables as a collective affect the dependent variable, despite the variables only explaining between 8% and 28% of the variance in the stock market (Wooldridge, 2006). As predictive ability is being assessed, the amount of variance explained by the model is less important than the variance in the dependent variable being affected by movements in the independent variables (Wooldridge, 2006).

In all stages of both tests the SA interest rate holds a statistically significant negative relationship with the South African stock market. The South African prime rate was used and thus it is movements in this rate that impact the South African stock market. This relationship indicates that the shifting of investment, when there is a change in the cost of capital (Alam & Uddin, 2009), has a significant impact on the prices of stocks within the South African market. Whether this effect is due to changes in investor behaviour because of changing investment opportunity costs, or due to company performance being affected by a changing cost of capital (Naik, 2013), is unconfirmed and beyond the scope of this study. Nevertheless, this factor is a potential predictive variable that investors should consider when investing in the South African market.

When assessing the economic significance of the results in Stage 1 of Test 1 it is noted that if South African interest rates were to change by 100-basis points i.e. 1% on a month-on-month basis there would be a 1.6% change in the stock market across the same period. Similarly, if there is a 100-basis movement in interest rates between two quarters (Stage 2 of Test 1) there is expected to be a 3.7% change in the stock market in the next quarter. On this basis, if investors believe interest rates will decline, they may take up the appropriate buy position in the stock market to take advantage of the expected increase in stock prices due to the identified relationship. The effect of the

change in interest rates may differ between different portfolio selections. This differing effect may be dependent on the relative debt to asset holdings of the investor and/or the effect of interest rates on the investments valuation. This consideration is beyond the scope of this study and may be explored in future research.

Additionally, it is noted that the SA Inflation rate holds a statistically significant negative relationship with the South African stock market at the 10% significance level. This relationship was only observed when testing the quarterly data in Stage 2 of Test 1. As no statistical significance was seen with this variable using quarterly data in Table 1, it might indicate potential interplay among the variables included in the model. Because of this, multicollinearity may exist between variables and this needs to be considered when assessing the results of the analysis. Multicollinearity exists when one predictor variable can be linearly predicted by another predictor variable within a model (Wooldridge, 2006). When this situation arises the coefficients of the model may become unstable⁷ and, as a result, the interpretation of their p-value may be affected (O'Brien, 2007). Thus, to assess whether this condition existed in the multivariate regressions, a Variance Influence Factor (VIF) was calculated. The VIF indicates by how much the regression coefficient is inflated due to multicollinearity within the model (O'Brien, 2007). This analysis was performed during Stage 2 of Test 1. The mean VIF was 1.05, with a variable specific VIF of 1.08 for the SA inflation variable. As a rule of thumb; a VIF above 4 is considered to indicate serious multicollinearity (O'Brien, 2007). Given the mean VIF of 1.05, Stage 2 of Test 1 does not exhibit serious multicollinearity. When considering the data set it was noted that the SA inflation variable was subject to less frequent changes monthly in comparison to the other selected variables. The less frequent change in the data may have been the cause for no significant relationship arising when assessing the monthly data during Stage 1 of Test 1 and Test 2. The quarterly data (Table 4, Test 1, Stage 2) is more likely to differ between each data point and, in turn, appears to hold a statistically significant relationship with the dependent variable.

⁷They are unstable as they are affected by relationships with other variables included in the model and consequentially are inflated. This inflated coefficient may then indicate potential significant relationships that do not exist (O'Brien, 2007).

In common with the results in Table 3, the FTSE Index shows a statistically significant positive relationship at the 1% level. This result shows a potentially predictive relationship, because the statistical significance holds after the inclusion of other control variables in the model. It is noted that a 1% change in the FTSE Index results in an equivalent change of 0.257% in the South African stock market. This change may indicate increased linkages between the markets from increasing international investment flows and increases in the number of dual listings over the period examined. This will be further explored in the structural break regression results to follow.

Dissimilar to what was seen in the output of Table 2, the variables Rand/Dollar exchange rate and US interest rates are no longer statistically significant upon the inclusion of the control variables in Table 4. Therefore, it appears that these variables may not be considered useful predictors of returns in the stock market given the significance of these variables being cancelled out when other market factors are considered.

This chapter will continue by presenting the results of the regression analyses run over the pre-crisis and post-crisis data sets, i.e. the structural break regressions.

STRUCTURAL BREAK REGRESSIONS

Due to the continuous nature of the time series data it was necessary to run two separate regressions, one on the pre-financial crisis data and another on the post-financial crisis data. The exclusion of the 2008 financial crisis period allows for the analysis of the predictive relationships in a bull market specifically. It also allows for the analysis of whether there has been a change in the significance and the direction of any relationship over time. The formulae relating to the structural break regression analyses are as follows:

$$JSE\ ALSI = \beta_0 + \beta_2 SA\ interest\ rate + \beta_3 Rand\ Dollar\ exchange\ rate \\ + \beta_4 SA\ inflation\ rate + \beta_5 SA\ Money\ Supply + \mu$$

Table 5: Test 1 – Stage 1

$$\begin{aligned}
JSE\ ALSI = & \beta_0 + \beta_1 SA\ interest\ rate + \beta_2 Rand\ Dollar\ exchange\ rate \\
& + \beta_3 SA\ inflation\ rate + \beta_4 SA\ Money\ Supply + \beta_5 US\ interest\ rates \\
& + \beta_6 Us\ inflation\ rate + \beta_7 US\ industrial\ Production + \beta_8 FTSE + \mu
\end{aligned}$$

Table 5: Test 1 – Stage 2

$$\begin{aligned}
JSE\ ALSI = & \beta_0 + \beta_2 SA\ interest\ rate + \beta_3 Rand\ Dollar\ exchange\ rate \\
& + \beta_4 SA\ inflation\ rate + \beta_5 SA\ Money\ Supply + \mu
\end{aligned}$$

Table 5: Test 2 – Stage 1

$$\begin{aligned}
JSE\ ALSI = & \beta_0 + \beta_1 SA\ interest\ rate + \beta_2 Rand\ Dollar\ exchange\ rate \\
& + \beta_3 SA\ inflation\ rate + \beta_4 SA\ Money\ Supply + \beta_5 US\ interest\ rates \\
& + \beta_6 Us\ inflation\ rate + \beta_7 US\ industrial\ Production + \beta_8 FTSE + \mu
\end{aligned}$$

Table 5: Test 2 – Stage 2

Table 5 presents the results of the multivariate regression analyses over two tests, each with two stages of testing. Test 1 is performed on pre-financial crisis data, while Test 2 on post-financial crisis data. In both tests monthly data was used. Quarterly data was excluded due to the lack of sufficient observations for the testing to be statistically sound. Stages 1 and 2 for both tests present the results when only SA macro-economic variables were included (Stage 1) and when SA and US macro-economic variables were included (Stage 2).

Table 5

Variables	Test 1: Pre-financial crisis		Test 2: Post-financial crisis	
	Stage 1:	Stage 2:	Stage 1:	Stage 2:
	Local variables	All variables	Local variables	All variables
SAInt	-0.025***	-0.0259***	-0.00966	-0.0122
	<i>-0.007</i>	<i>-0.0067</i>	<i>-0.0118</i>	<i>-0.0114</i>
Log_RD	0.096	0.104	-0.296***	-0.218**
	<i>-0.112</i>	<i>-0.115</i>	<i>-0.0882</i>	<i>-0.0893</i>
Log_M0	-0.139	-0.108	-0.0811	-0.0471
	<i>-0.096</i>	<i>-0.0981</i>	<i>-0.097</i>	<i>-0.095</i>
SAInfl	-0.011*	-0.00994	-0.0171	-0.0145
	<i>-0.00582</i>	<i>-0.00603</i>	<i>-0.0124</i>	<i>-0.0126</i>
USInt		-0.00942		-0.219*
		<i>-0.0244</i>		<i>-0.12</i>
Log_FTSE		3.348*		2.644*
		<i>-1.751</i>		<i>-1.435</i>
USInfl		-0.00783		0.00171
		<i>-0.012</i>		<i>-0.00751</i>
Constant	0.013***	0.0150**	0.0113***	0.0110***
	<i>-0.00419</i>	<i>-0.0063</i>	<i>-0.0028</i>	<i>-0.00374</i>
N	141	140	93	93
F (4, 252)	4.82	3.21	4.78	4.29
Prob > F	0.0012	0.0036	0.0015	0.0004
Root MSE	0.4764	0.04753	0.02559	0.0247
R²	0.116	0.145	0.179	0.261

Standard errors in italics

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Similarly, to the tests in Table 4 it was noted that the multivariate regressions each have an R^2 below 1, indicating a potential lack of goodness of fit. As discussed previously the low R^2 indicates that there are factors affecting the South African stock market that have remained unaccounted for within the model. However, this deficiency does not necessarily imply that these unaccounted for factors are correlated with the stock market (Wooldridge, 2006). The F-Test was performed as a post-estimation tool to consider whether the above factors do collectively affect the dependent variable. The test indicated both stage of both tests having a significant F-Test statistic at the

1% level. Thus, the model is sufficient to consider relationship between these variables and the stock market despite the low R^2 values.

In both stages of testing on pre-financial crisis data i.e. Test 1, SA interest rates hold a statistically significant negative relationship with the South African stock market. However, the relationship is not statistically significant when using data post the 2008 financial crisis i.e. Test 2.

Further examination of these two datasets revealed that the mean change in interest rate in the pre-crisis data (-2.1% or 201 basis points) was higher than the mean change in interest rates in the post crisis data (0.7% or 70 basis points). This difference may indicate that there is a strengthening in the relationship between the stock market and interest rates when the movements in interest rates are larger. This assumption is in alignment with the concept that investors will change their investment allocation decision when interest rates change because the incremental change in value will be greater when higher interest rates are being experienced. Thus, this difference in the level of change in interest rates across the two periods examined may be the cause of the difference in this relationship. Consequentially, interest rates may only be a useful predictive tool in an environment in which changes in interest rates are large.

Additionally, the change in the significance of the relationship may be affected by investor sentiment post the crisis period (Bandopadhyaya & Truong, 2010). The 2008 financial crisis was a result of a breakdown in the lending system in Northern America (Acharya & Richardson, 2009). This banking system breakdown may have led to a decline in confidence in the lending system, resulting in a behavioural change (Necker & Ziegelmeyer, 2014) with interest rates of banks having less of a role in investment decisions for local investors. This conjecture may perhaps be explored via further analysis of the ratio of debt to equity investments made both pre- and post the crisis period.

When considering the US interest rate, a statistically significant negative relationship at the 10% level is seen in Test 2 of Table 5, despite no statistically significant relationship in Table 4, nor in Test 1 of Table 5. This difference might be a result of increased foreign investment and/or stock market contagion after the said financial

crisis (Bekiros, 2014). When international investors make investment decisions, their cost of capital and return on investment may not only be determined in the country of the investment, but also the originating country of investment (Crespo & Fontoura, 2007). Thus, the US Interest rate may have an increased effect on international investors' investment decisions post crisis (due to increased globalisation and international trade) resulting in a relationship between this variable and prices on the South African stock market in Test 2 of Table 5.

In Table 5, the SA inflation rate holds a statistically significant negative relationship (at the 10% level) with the stock market, but only in Stage 1 of Test 1 i.e. pre-crisis data when only local macro-economic variables are considered. As such, multicollinearity was considered⁸. The calculated mean VIF was 1.07 (Table 5, Test 1, Stage 1), indicating relatively more collinearity between variables within the regression than what was identified in Table 4 (Stage 2, Test 1). When analysing the VIF for individual factors, it was noted that the SA interest rate and SA inflation rate variables had the two largest VIFs in the model (1.13 and 1.08 respectively). However, these numbers are still well below the threshold of four⁹ resulting in the conclusion that statistically significant multicollinearity does not exist in the model (O'Brien, 2007). It appears that the results of the test indicating a statistically significant relationship may be due to an anomaly, indicating this variable is a less consistent predictor of the market.

The FTSE Index continues to hold a statistically significant positive relationship with the SA stock market, over all time periods examined i.e. pre-crisis in Test 1 of Table 5, post-crisis in Test 2 of Table 5, and the complete period in Table 4. This indicates consistent predictive ability of this variable, which might be expected with continual contagion and the increase in the mobility of investment between markets (Carmody,

⁸ Multicollinearity was considered due to the differing results of the tests performed. Multicollinearity exists when one predictor variable can be linearly predicted by another predictor variable within a model (Wooldridge, 2006). This may have been the cause of the differing results, thus the VIF was calculated and assessed.

⁹ As a rule of thumb; a VIF above 4 is considered to indicate serious multicollinearity (O'Brien, 2007).

2002). The economic significance of this relationship in the pre-crisis period indicates the South African stock market may experience a 3.348% change in value when there is a 1% percentage change in the value of the FTSE index. This size of the change in the SA stock market value is slightly lower at 2.655% in the post-crisis period. This information may aid the portfolio investment decisions of investors who are exposed to both markets. It appears that these markets may be subject to similar risks (causing them to move together) resulting in potential risk diversification difficulties in portfolio selection.

Furthermore, when comparing the size of the coefficients in Table 4 to those in Table 5 (i.e. the monthly regression across the full data set from 1995 - 2016) it is noted that the size of the coefficient for the FTSE index has increased when the financial crisis period was excluded (regression coefficient in the full data set was 0.257 while the coefficients were 3.348 and 2.644 in the pre- and post-crisis period respectively). This might indicate that during the crisis period, the markets may have been exposed to different market movements, resulting in a smoothing out of the size of the regression coefficient across the period examined. This further indicates that during non-crisis periods the relationship between the FTSE index and the SA stock market may be expected to yield larger changes in value. As the SA and US stock markets may be influenced by similar economic factors, this might create a spurious¹⁰ relationship between the two variables. This hypothesis could be further explored by conducting a regression analysis over both markets and comparing the effect of the same selected variables in each of these markets. Practically, investors could use movements in the FTSE Index to anticipate movements in the South African stock market. Further regression analysis should be employed which include lags to determine the optimal prediction lag length. This is a suggested area for further research.

The last noteworthy finding from Table 5 is the negative relationship between the Rand/Dollar exchange rate and the South African stock market ((As the Rand/Dollar

¹⁰ A spurious relationship is one where two variables incorrectly appear to be causally related when they are not. This may occur as a result of another unidentified variable not included in the model that may be causing the appearance of a relationship between these variables (Wooldridge, 2006)

rate weakens, i.e. the cost in Rands of a Dollar is less, the stock market will experience a positive movement). This is only statistically significant in Test 2 i.e. in the post-crisis data. Assessing the economic significance of the relationship in Stage 2 of Test 2 (in which all variables in the model are accounted for), if the exchange rate worsens by 1% (i.e. the Dollar costs more Rands) the stock market value will fall by 0.218%.

Upon further analysis of the Rand/Dollar exchange rate, it can be observed that during both the pre-crisis and post-crisis datasets, there was a positive trend overall (see Figure 2 and Figure 3 in Appendix D) indicating a steadily weakening of the Rand/Dollar exchange rate over time. The gradient of this weakening was higher with the post crisis data. Therefore, the statistical significance of this relationship in Test 2 of Table 6 may be linked to the increase in the gradient in the post-crisis data i.e. there appears to be a stronger relationship between the stock market and the exchange rate when the rate of change is higher. This increase in the rate of change indicates greater exchange rate volatility which, in turn sways investor sentiment via the impact on investment value uncertainty (Mavee & Perrelli, 2016). Increasing exchange linkages and levels of contagion between the two economies (SA and US) (Bekiros, 2014) may also contribute to the increase in significance of this relationship post-crisis.

CONCLUSION AND RECOMMENDATIONS

The objective of this study was to assess whether selected South African and international macro-economic variables may be classified as predictors of returns in the South African stock market. The study identified South African interest rates and the FTSE Index to hold the most consistent statistically significant relationship with the South African stock market.

The statistically significant positive relationship of the FTSE Index variable across much of the testing supports the predictive ability of this particular index. Therefore, investors should consider the relationship between the two markets when making investment decisions. The negative relationship with the SA interest rate appears to be more prevalent when there are larger changes in the interest rates.

The Rand/Dollar exchange rate shows predictive ability post the financial crisis. This finding may have been due to increased exchange rate volatility in the post-crisis period, impacting on the value of investments. This volatility may have also resulted in investor uncertainty, thus causing the stock market to rise and fall with the worsening and the appreciation of the Rand/Dollar exchange rate. Additionally, the observed relationship may be due to increased levels of international contagion between the economies, emphasising the importance of changes in this variable when considering investment in the South African stock market.

The macro-economic variables were selected based on financial and economic theory and variables tested in prior studies. It has been noted that in this study and in the literature reviewed, that theory and practice often do not align. Furthermore, the stock market and the selected macro-economic variables do not operate in isolation and are, consequentially, impacted by other exogenous factors that may not have been considered within this study. Several of the selected variables indicated no significant relationships with the South African stock market. This may be due to the South Africa stock market exhibiting a level of market inefficiency, the infrequency of information availability, the irrationality in investor behaviour or the influence of unidentified factors within the market.

AREAS FOR FUTURE RESEARCH

Often money supply, interest rates and inflation are collectively related via their role in monetary policy (Friedman, 1968). Given this fact it may be difficult to assess the specific influence of each of these variables on the stock market because their regression relationship may be distorted due to relationships between these variables. This occurrence was particularly relevant given the inconsistency of the relationship between South African inflation and the South African stock market. Thus, the relationship between these variables may be further explored in an additional study via the use of interaction terms.

In the analysis of the results relating to South African interest rates and the South African stock market, it was noted that the cause of the relationship between these two variables may be due to either changes in investor behaviour because of changing

investment opportunity costs, or a result of company performance being affected by a changing cost of capital (Naik, 2013). This relationship may be explored in future research via survey analysis over investors sensitivity to changes in the debt market, coupled with sensitivity analysis of company valuations in relation to changes in the debt market.

The FTSE Index was observed to hold a statistically significant relationship with the JSE All Share Index that may indicate potential linkages between these two stock exchanges and stock markets. Further work to assess whether the FTSE and JSE Indices are influenced by similar selected macro-economic variables should be undertaken. Furthermore, the results of this study may be further explored by examining the optimal lag length for the significant relationships identified, allowing investors insight into the optimal timing of when to take advantage of movements in macro-economic variables.

The JSE All Share Index experienced differing levels of concentration of industries over the period examined. This may have played a role in the differences between the relationships identified in the pre-crisis period and the post-crisis period. This study could be expanded by assessing whether the identified relationships are subject to change when indices of differing compositions are included (e.g. the SWIX Index or RESI Index).

Lastly, assessing daily data (as opposed to monthly and quarterly data) may result in the strengthening of the relationship between the selected variables and would provide investors with useful information in relation to day trading.

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APPENDIX

APPENDIX A

Table 1 presents the dependent and independent variables used in this study. The 'mp' and 'qp' in each variable name refers to the period to which each data set relates i.e. 'mp' refers to variables from the monthly data set and 'qp' to variables from the quarterly data set.

Table 6: Variables Tested

Variable	Variable Name	Source
South Africa stock market	Log_ALSI_mp Log_ALSI_qp	I-net
South African GDP	Log_SAGDP_qp	StatsSA
United States GDP	Log_USGDP_qp	I-Net
South African interest rate	SAint_mp SAint_qp	South African Reserve Bank
US interest rate	USint_mp USint_qp	I-Net
South African inflation	SAinfl_mp SAinfl_qp	StatsSA
US inflation	USinfl_mp USinfl_qp	I-Net
South African money supply	Log_M0_mp Log_M0_qp	South African Reserve Bank
Rand/Dollar exchange rate	Log_R/D_mp Log_R/D_qp	I-Net
FTSE	Log_FTSE	I-Net

APPENDIX B

DETAIL ON THE AUGMENTED DICKEY- FULLER TEST

The Augmented Dickey-Fuller (ADF) Test is commonly used to test for stationarity in econometric data (Bekhet & Matar, 2013; Macfarlane & West, 2011; Narayan, Narayan & Thuraisamy, 2014) and is an extension of the Dickey-Fuller (DF) test. To ensure that regression results can be used to draw reliable conclusions, the ADF test transforms non-stationary times series data into stationary data.

The DF test (Dickey & Fuller, 1979) was developed to test whether a variable contains a unit root. However, this original model did not consider serial correlation that may exist in the dataset. Therefore, it was modified to control for serial correlation¹¹ in the Augmented Dickey- Fuller (ADF) test.

The ADF test attempts to identify if the time series data contains a unit root. If a unit root exists it indicates a data set as being non-stationary. Non-stationarity implies each data point not being independent of one another and thus interpretation of the regression results over time may consequentially be inaccurate (Talla, 2013).

The test for stationarity takes place over the logarithmic transformed variables. This is consistent with prior literature (Macfarlane & West, 2011; Ouma & Muriu, 2014; Tripathi & Seth, 2014). The test includes lags within the model, to consider potential serial correlation. To ensure that an appropriate lag length is selected the ADF test will be run for each variable including both the Maximum lag length as defined by Schwert, (1989) and the Sequential T-method lag length defined by Ng and Perron (1995). The results of the tests with the differing lags will be compared and then it will be assessed whether the time series data exhibits stationarity or if it contains a unit root. If a variable contains a unit root, this non-stationary time series data will be subject to differencing (Shawtari *et al.*, 2016; Talla, 2013). The ADF test will then be run over the differenced variable to assess whether the differenced variable exhibits stationarity or if it contains

⁸ Serial correlation in time series data indicates that the data points are not independent of one another and as a result a future data point may be impacted by movements in a past data point (Pindyck & Rubinfeld, 1998).

a unit root. This transformation and testing process will be repeated until the variable achieves stationarity.

A lag is included in the ADF test to account for potential serial correlation within the data set. The appropriate lag length can be determined using a variety of methods. Two such methods are used in this study, namely 1) the P_{max} lag length method and 2) the sequential t-method.

For the P_{max} lag length method, the determination of the appropriate lag length can be calculated using a method proposed by Schwert (1989):

$$P_{max} = \lceil 12 \cdot (T/100)^{1/4} \rceil$$

Where, T represents the number of data points in the set, and Pmax represents the maximum lag length that should be specified for the ADF test. If the lag length that is chosen for the test is too small, there may still be serial correlation in the data set of the variable that is not controlled for (Ng & Perron, 2001). Alternatively, if the lag length is too large then the power of the test will suffer.

For the sequential t-method, the absolute value of the test statistic of the last lag (using the P_{max} lag length method) is assessed. If above 1.6 in value, the unit root test using the maximum lag length is performed. If the test statistic is lower than the absolute value of 1.6 the lag length is then reduced by 1 and the described sequential process will be re-performed until a lag length that meets the above criteria is achieved (Ng & Perron, 2001).

APPENDIX C

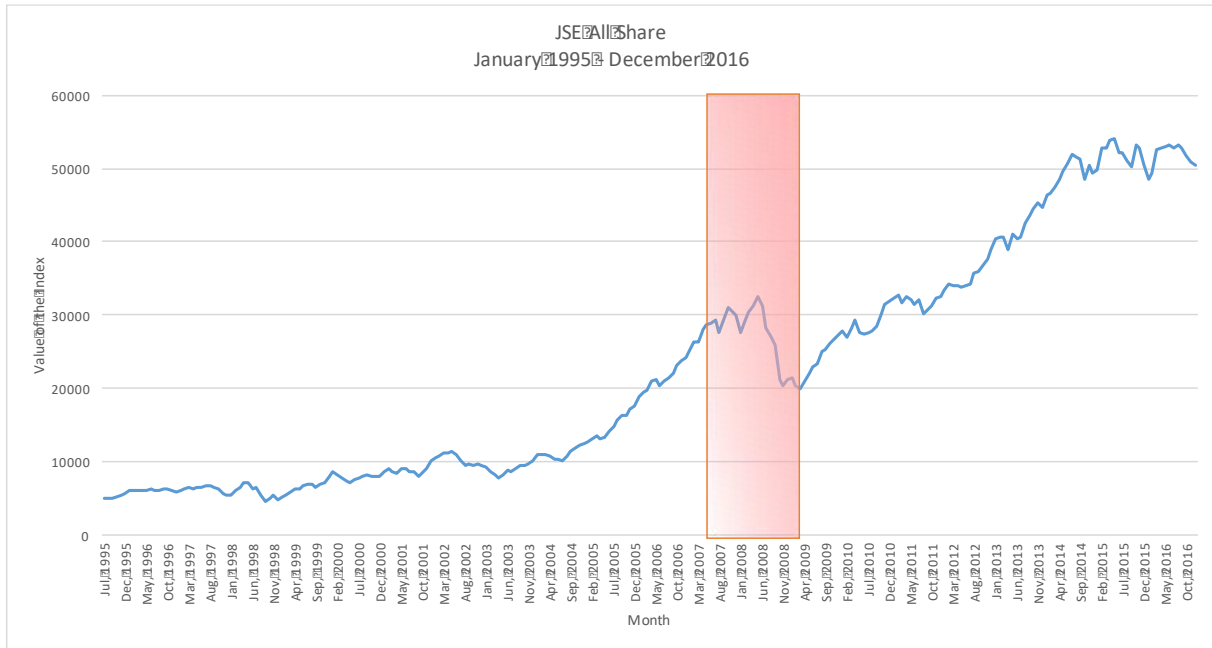


Figure 1: Financial Crisis Period

APPENDIX D

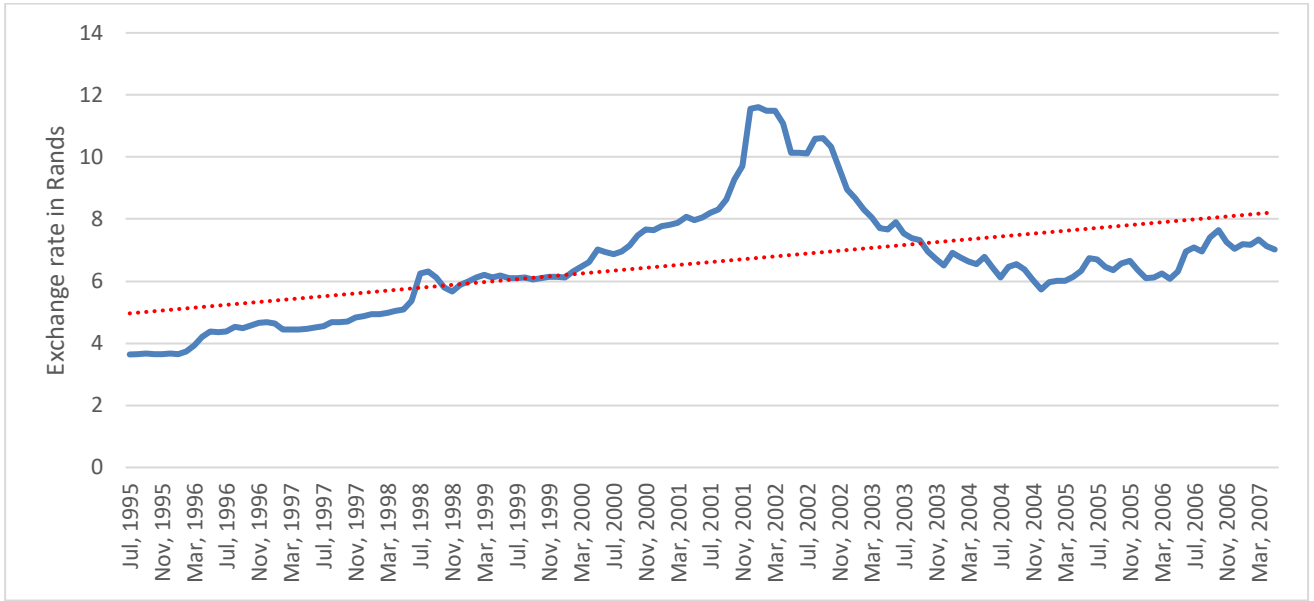


Figure 2: Rand/Dollar exchange rate pre-crisis

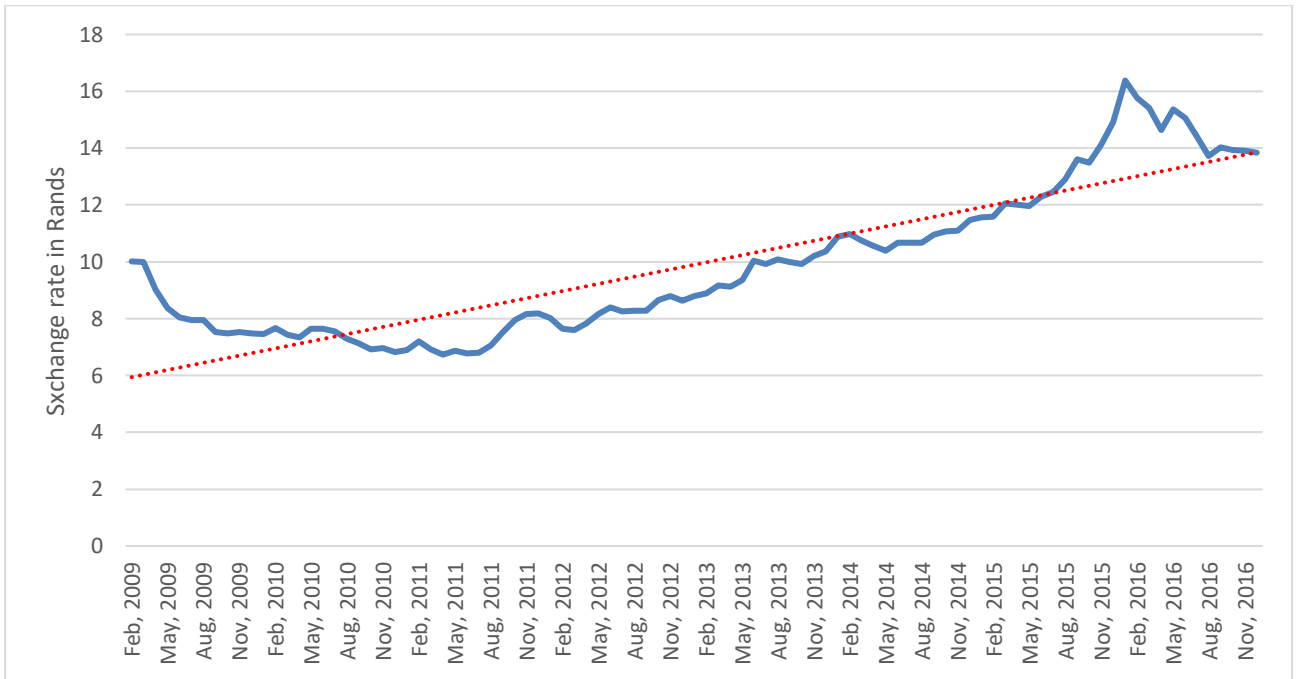


Figure 3: Rand/Dollar exchange rate post-crisis