

AN ANALYSIS OF THE INFLUENCE OF DOMESTIC MACROECONOMIC VARIABLES
ON THE PERFORMANCE OF SOUTH AFRICAN STOCK MARKET SECTORAL INDICES

by

Ryan Lee Hancocks

Student number: 602H0463

A thesis submitted in partial fulfilment of the requirements for the degree of

MASTER OF COMMERCE (FINANCIAL MARKETS)

Department of Economics and Economic History

Rhodes University, Grahamstown

Supervisor: Prof. Geoffrey Antrobus

Co-Supervisors: Prof. Gavin Keeton and Mr Zivanemoyo Chinzara

February 2010

DECLARATION

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

Signed by _____ on this 18th day of February 2010.

Abstract

An econometric study was undertaken to determine the extent to which selected macroeconomic variables influenced stock market prices on the All-Share, Financial, Mining and Retail Indices of the Johannesburg Stock Exchange in South Africa from 1996:7 to 2008:12. The Johansen cointegration method was used to determine whether cointegrating relationships existed between the macroeconomic variables and the stock market indices. A Vector Error Correction model was estimated and found significant results that money supply, inflation, long and short- run interest rates, and the exchange rate all had an influence on stock market prices. Further, the VECM results for each sector indicated that certain macroeconomic variables had differing influences on each sector of the stock market. Impulse Response tests indicated that the selected macroeconomic variables caused shock to the sectoral indices in the short-run but that the effect was lagged. The Variance Decomposition tests conducted supported earlier evidence that the macroeconomic variables had a strong level of sectoral index determinacy in the long run.

The results found that the All-Share and Financial Indices were negatively influenced by inflation and short term interest rates in the long run, while the Financial Index also had a negative relationship with long-run interest rates. Money supply was found to have a positive effect on all the indices. A weakening of the exchange rate was found to have a positive influence on both the Retail and Mining Indices, while it negatively affected the All-Share and Financial Indices. The long-run interest rate had a positive influence on both the Retail and Mining Indices.

Overall the study finds that macroeconomic variables are important determinants of stock market prices in South Africa and that it is important to examine each sector of the stock market separately to capture what are different effects. The limitations of the study are that a different measure for exchange rates from the nominal rand/dollar exchange rate used here may yield more decisive results and provide insight into the link between exchange rate behaviour and performance of especially the retail sector.

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Chapter 1: Introduction

Empirical work has long existed demonstrating causality between stock market pricing and macroeconomic variables. Moolman and DuToit (2005), Van Rensburg (1998) and Olalere (2006) stand out as researchers into the relationship between macroeconomic variables and the South African stock market, while Maysami, Howe and Hamza (2001,2002,2004) and Mukherjee and Naka (1995) present empirical work on the same relationships globally. The wealth of research on the relationship between macroeconomic variables and overall stock market pricing will be presented in the literature review. This study seeks to further that research by providing a view of the links that selected macroeconomic factors such as inflation, long and short-term interest rates, money supply and exchange rates (specifically the rand/dollar exchange rate) have not just on the overall South African stock market but also on individual sector indices of the stock market. The relationship with the All-Share Index is examined first and then the analysis is extended beyond that of most previous studies of the South African market to include an examination of the links between macroeconomic variables and the retail, financial and mining sectors of the Johannesburg Stock Exchange (JSE). Such an approach is likely to provide a more reliable analysis of the importance of macroeconomic variables and stock market prices than previous analyses for South Africa which looked mainly at the All-Share Index. This is because one would expect *a priori* that the impact of macroeconomic variables will be different for different sectors. For example, a change in interest rates is likely to have a greater impact on the retail and financial indices than on the resources sector. In contrast, a change in the rand/dollar exchange rate is likely to affect the resources index much more than it will the financial index. Inflation and money supply are both expected to have the same influence over all indices as their effects are broad ranging in the South African market.

In line with previous global research the Johansen cointegrating approach will be used to determine the extent of cointegration between the identified sectors of the JSE and macroeconomic variables in South Africa during the period 1995–2008. A vector error correction model (VECM) analysis will then be conducted to establish the sign and magnitude of each cointegrating vector. The VECM model will also provide an error correction coefficient which will provide the speed of adjustment for the indices examined. Impulse response and

variance decomposition tests will then be conducted to examine the effect that each macroeconomic variable has in the short term along with the magnitude of their influence and shocks to the indices.

Being able to comprehend the magnitude and duration of the effect that shifting macroeconomic factors have on the sectoral performance of the JSE may enable investors to more accurately anticipate stock price movements and general trends in equities contained within select economic groupings. This foresight will provide both a platform for the understanding and translation of macroeconomic factors in the market as well as tangible evidence of the size of the delay in any effect that macroeconomic shifts may propagate within the equities market in South Africa. This provision of information would thus enable investors to overcome some of the inherent volatility within the market by being able to interpret early market signals and react to them accordingly. An understanding of market behaviour in this manner leads to a more efficient and investor friendly market environment.

The main objective of this study is thus to examine the relationship between selected macroeconomic factors and the All-Share, Financial, Mining and Retail Indices on the JSE, and to determine whether any cointegrating relationships exist between these variables. This main objective is then further explored through the following sub-objectives:

- to determine the magnitude and significance of macroeconomic variable impacts on selected indices;
- to determine how the selected stock market indices respond to shocks, and which shocks create the greatest shift in the selected indices; and
- to determine whether selected stock market indices have opposite or differing behaviour to the expected normal outcome in relation to the influence of selected macroeconomic variables.

The organisation of this study is as follows: Chapter 2 will look at the theoretical and empirical review of literature based on macroeconomic variables and their effect upon stock market prices using cointegration and VECM approaches. Chapter 3 will present a brief history of the selected macroeconomic variables in South Africa and their performance for the period of the study. Chapter 4 provides the method of study and a description of the data used for cointegration analysis. Chapter 5 provides the empirical results, the analysis tests performed, the sectoral results and their interpretation. Chapter 6 offers the conclusion of the findings as well as a provision for further research and a discussion of the limitations of the study.

Chapter 2: Literature Review

In this chapter an analysis of the theoretical background behind macroeconomic factors and their influence on stock prices as well as previous research into these relationships is examined. The Efficient Market Hypothesis is briefly examined followed by an in-depth examination of the Gordon Growth Models and Arbitrage Pricing theory. Empirical evidence is provided from the theoretical foundations to support the basis for the study. The empirical evidence covers developed, developing and, lastly, the South African stock market.

2.1 Theoretical Background

The theoretical background that substantiates the interaction of macroeconomic factors with stock prices is based on three models, the Efficient Market Hypothesis (EMH), the Present Value Model (PVM) (and its later derivation the Gordon Growth Model) and Arbitrage Pricing Theory (APT).

Moolman (2005:80) states the EMH's theoretical understanding that prices adjust themselves rapidly and in an unbiased manner to relevant and price-affecting factors in the market. Thus, while these changes are not necessarily correct they are unbiased and through a period of changes will result in the optimum price level for the market. The conclusion of the EMH is therefore that investors in the capital markets cannot achieve returns that are above average by using the information and historical data presented by the market. Trend-based analysis will therefore not return above average results. Consequently, Moolman (2005:80) points to the fact that fundamental analysis of the intrinsic value of an underlying security and the economic variables affecting it will be able to yield returns that are above average only for a short period of

time. In contrast, an estimation of macroeconomic factors (such as inflation, interest rates and economic growth) may reveal differing growth prospects for relevant industries. An analysis of the intrinsic value of a security and how expected changes in macroeconomic factors affect the underlying price of the security will therefore reveal security prices that are either under- or over-valued in respect of their market price at a given point in time. Investment in such securities will produce above average returns. It should be noted that such better-than-average returns will be eroded as the excess returns on the security cause a subsequent relational adjustment of the securities price to the market price and thus bringing it back to market averages if the EMH holds.

The next theoretical model is the Present Value Model (or Constant Growth Model [CGM]) Moolman (2005:80) points out that the price of a security is equal to the present value of its expected future dividend stream. Thus the expected capital gain on the sale of said security is used in price estimation since its size also depends on the present value of its expected future dividends. The assumption in Moolman (2005) is that expected dividends would grow at a constant rate, thus the problem of estimating an infinite future dividend stream can be replaced by estimating an expected growth rate in its place. Thus it can be subsumed that in the present value model security prices are determined by the dividends and the discount rate. Smith (1925) thus states the PVM as:

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

where P_i is the current share price, $D_{i,t+n}$ is the future dividend payments to be discounted.

Present value and $(1+k_i)^n$ is the discount factor with k as the discount rate applicable.

Accordingly, the prevailing share price can be solved from the above equation by setting $t = 0$ as follows:

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

This equation thus allows for the understanding of stock valuation at $t = 0$ by calculating its value of all future dividends discounted to the present value. A simplifying assumption of this

model is that the dividend payments are fixed, as is the rate at which these dividends are discounted. Thus, incorporating the fixed rates presents the following formula for the pricing of equities:

$$P_e = \sum_{t=1}^n \frac{D}{(1+R)^t} + \frac{E(P_{en})}{(1+R)^n}$$

$E(P_e)$ denotes the expected price of the share in a given year (n). As such the value of the equity is the sum of all discounted dividend payments due in future periods plus the discounted expected value of the share's price in year (n). What this model aids one in understanding is that any macroeconomic factor which has an influence over discount rates or future dividend returns will also influence the outcome of equity pricing.

Gordon (1962) proposes an update to the PVM to improve on its assumption of a constant stream of fixed dividends. The basic Gordon Growth Model (GGM) proposed by Gordon (1962) is able to overcome the deficiencies of the PMV by allowing the dividend payments in the future to change. This is achieved by allowing dividends to grow at a set rate per annum, the resulting GGM equation being:

$$P_e = \frac{D_1}{R - g}$$

Here the price of an equity is defined as the current dividend divided by the rate of return required by the market less the expected future rate of growth of the dividend. The understanding that can now be derived from this model is that there are three factors that determine the prices of equities:

- the forthcoming dividend (as shown by [D_1]) which is decided by the level of profitability in the firm and the current macroeconomic environment (which impacts on the firm's overall profitability and sustainability);

- the expected rate of growth of the dividends (g) which is also influenced by economic growth and macroeconomic factors;¹
- the rate of return required by the market participants (R) – a higher required rate of return would denote a riskier investment to the market and thus the possibility of lower future dividends for the equity and hence a lower equity price in the market.

What can be taken from this model of equity prices is the observation that the rate of inflation, interest rates, money supply and various other macroeconomic factors all have an influence on the outcome of either the discount rate or dividends earned on securities. The basic GGM however had a notable deficiency, this being the assumption of constant dividend growth. Such an assumption may prove unreliable in its assumption that a firm's profit will be sustained in the long run. Gordon thus amended his GGM to a two stage model, which now could take into account a high and strong dividend growth rate in the short run combined with a second stage lower but sustained dividend growth rate phase in the long run. The two phase GGM is thus:

$$P_0 = \sum_{t=1}^{t=n} \frac{DPS_t}{(1+r)^t} + \frac{P_n}{(1+r)_n}$$

Where:

$$P_n = \frac{DPS_{n+1}}{r_n - g_n}$$

P_0 = Price of share in year 0

DPS_t = Expected dividend per share in year t

P_n T = Terminal value (which is the price of share at end of year n)

r = Required rate of return in high growth stage

¹ A point of interest in this study is that sectoral factors may well have a significant outcome on the rate of the growth of dividends – and hence on equity pricing – due to the differing growth rates attributed to different sectors in the South African economy.

g = Dividend growth rate in high growth stage

r_n = Required rate of return in stable growth phase after year n

g_n = Dividend growth rate in stable growth phase after year n

Goodspeed (2004) points out the limitations of the two-stage GGM as being the difficult nature of estimating the end of a high growth period and the timing of its transition into the lower growth phase. These limitations brought about the three-stage GGM. Goodspeed (2004) explains this model as involving the original high growth and infinite stable phases, but a new stage is added between the two. This transition or decline stage now augments the model and helps take into account the period of uncertainty and change involved between the short- and long-run stages in the model. The three-stage GGM is thus represented below:

$$P_0 = \sum_{t=1}^{t=n1} \frac{EPS_0(1+g_a)^t \times PO_a}{(1+r)^t} + \sum_{t=n1+1}^{t=n2} \frac{DPS_t}{(1+r)^t} + \frac{EPS_{n2}(1+g_n) \times PO_n}{(r_n - g_n)(1+r)^n}$$

Where:

EPS_t = earnings per share in year t

DPS_t = dividend per share in year t

g_a = growth rate in high growth stage for $n1$ period

g_n = growth rate in stable growth stage

PO_a = payout ratio in high growth stage

PO_n = payout ratio in stable growth stage

r = rate of return in high growth stage

r_n = rate of return in stable growth stage

Though Gordon's three-stage GGM tries to account for earlier deficiencies, the basic tenets of the model still remain overly rigid and uncompromising in terms of their demands on dividend growth streams. What this model aids is an understanding of the interplay that macroeconomic factors have in determining the variable factors in equity pricing and dividend streams.

The third model of equity pricing, Arbitrage Pricing Theory (APT), is explained by Maysami (2005:48–49) as looking to quantify the risk premia associated with various economic factors that influence the returns on assets and, thus, whether or not these are significant and therefore included in the price of securities. If discount rates are affected by economic factors (or if future dividend payments are affected by these factors) it can be concluded that macroeconomic variables must have an influence on the pricing of market securities. Paavola (2006:6) states that APT shows risk in two forms. The first is the risk associated with macroeconomic factors affecting all securities. This is a pervasive risk and cannot be diversified away. The second source of risk is that risk which is unique to each security and sector as well as being non-systemic in nature. This risk can be diversified away through portfolio diversification. Thus efficient markets will only deliver excess returns above the average for the market based on the systemic or macroeconomic risk factors such that greater returns will require a greater burden of risk being taken on the investment.

2.2 Global and Developed Market Evidence

For portfolio holders to more fully understand the underlying influence that macroeconomic factors such as inflation, interest rates, money supply and exchange rates have on equity prices, a study of the relationship between these variables and the stock market is necessary. Studies that have examined the influence of macroeconomic factors on global financial markets will be discussed in this chapter. A key deficiency that is identified throughout this field of study is the sparse amount of research conducted on the individual market sectors and how each sector could

have a differing response to changes in macroeconomic variables. This study will similarly examine the cointegration relationship between macroeconomic variables and the composite stock market index for South Africa but will also explore the relationships between the macroeconomic variables and the Financial, Industrial and Retail indices. The question of such a relationship is a key factor when examining domestic policies that impact on macroeconomic variables or explaining the consequences of changes in stated macroeconomic variables as the positive and negative changes in the domestic stock market may also have far-reaching effects on the economy. The macroeconomic variables highlighted in the papers analysed have also been identified.

Nikkinen et al. (2006) showed that United States macroeconomic announcements had an effect on investor behaviour (and therefore stock prices) in foreign markets (mainly G7 countries) as well as in a limited number of emerging markets that did not exhibit market segmentation.

Gunsel et al. (2007) performed a sectoral study on the effect of macroeconomic factors, as well as industry specific variables, risk premia, and sectoral unanticipated dividend yields on London Stock Exchange returns. They found evidence that the variables identified (term structure of interest rates, unanticipated inflation, unanticipated sectoral industrial production, risk premium, real exchange rate, money supply and sectoral unanticipated dividend yield) all had a significant effect on investment returns. More conclusive findings were that different industries sometimes had opposite results for the variables used. Unanticipated dividend yield had a significant and negative result for all industries. Unexpected inflation was found to have a significant and negative effect on the food, beverage and tobacco sectors. Risk premium had a positive and significant effect on the construction and engineering sectors. The effective exchange rate had a significant and positive effect on the chemical sector, but a negative and significant effect on the building materials and merchants, and engineering sectors. Money supply had a positive and significant effect on the building materials and merchants, as well as the food, beverage & tobacco sectors while a negative relationship was found with household goods and textiles. One-month-lagged-term structure of interest rate was found to have a positive and significant

relationship with the construction; food, beverage and tobacco; oil exploration and production; and electronic and electrical equipment sectors. Unanticipated sectoral production was found to have a negative and significant effect on the food, beverage and tobacco and engineering industries. The one-month-lagged value of this variable had a positive effect on the household goods and textiles industry, while the three-month-lagged value had a negative effect on the paper, packaging and printing industry. The causes of these differences was attributed to the differing nature of dividend yields within the industries analysed as well as the various exposures present in each sector to global macroeconomic factors such as the exchange rate's effect on import and export revenues, while interest rate yields will have a stronger influence over domestic lending dependant sectors such as the financial sector. Unusually, in this study unexpected variables were used. What we should note is that the market's response is different from the normal expected outcome and, though no other studies examined in this paper use unexpected variables, their interaction with market expectations and the outcomes presented in the paper lend a deeper insight into the effect that macroeconomic variables have on market returns, especially how returns can differ from sector to sector with respect to their sign.

Simpson (2002) examines how bank stock returns are influenced by the macroeconomic variables of interest rates and exchange rates. Johansen cointegration, Granger causality tests and a VECM model are used to determine the interaction between the variables. No evidence was found to support bank stock returns being influenced by short- or long-term interest rates or exchange rates for the period of the study. Evidence was present that causality ran from bank stock returns to interest rates and exchange rates in the Australian case. The paper evidences this as an occurrence of the government and policy maker reliance on the stability of the banking sector when formulating monetary and exchange rate policy.

Karamustafa and Kucukkale (2002) looked at the degree of causality between macroeconomic variables in Turkey and stock prices on the Istanbul stock exchange. The Johansen and Juselius Cointegration test results identified two cointegrating vectors. These were that stock prices have a positive relation to the Industrial Production Index, the exchange rate (in USD) and money

supply M2, but had a negative relation to the trade balance. The interesting outcome of this study was however that the Granger causality tests performed showed that the direction of causality ran not from the variables to stock prices but that rather stock prices had an influence on all the macroeconomic variables.

Leigh (1997) performed a study on the efficiency form of the Singapore stock market. Using a Johansen cointegrating multivariate VAR, it was found that the stock exchange was semi-strong/weakly efficient. Thus, stock prices would incorporate current macroeconomic variables as well as past prices. He found that stock returns cointegrate with the macroeconomic variables, M2 money supply, GDP, consumption, real exchange rate, the prevailing domestic interest rate, as well as the level of wealth and investment present on the stock exchange.

Mukherjee and Naka (1995:234) found that a significant relationship existed between the macroeconomic variables (exchange rate, inflation, money supply, real economic activity, long-term government bond rates and the call money interest rate) and stock market returns in Japan, and that changes in the variables translated through into movements in the market. The outcomes showed evidence that the long-run elasticity coefficients for the macroeconomic factors were in accordance with the predicted signs. That is: they hypothesised and found that positive relationships existed for the exchange rate, money supply, real economic activity and the call money rate. A negative relationship on stock prices was expected and found for inflation and long-term government bond rates. Long- and short-term interest rates on the Tokyo Stock Exchange were found to move in opposite directions. This was explained by the long-term bond rates serving as a better risk-free nominal rate surrogate for the discount-rate valuation model used in stock pricing. While the study carries out a thorough examination of the overall market what is found lacking is an analysis of the forces underlying and contradicting each other in the different market sectors which comprise the economy.

Bordo and Wheelock (2006) analysed the debate over causes of stock market booms in developed countries and found that inflation influenced the market with booms resulting from periods of low and declining inflation and coming to an end when inflation began to rise again.

A benchmark study by Fama and French (1989) looked at the effects of business conditions on stocks registered on the New York Stock Exchange. A multiple regression estimation was used to show that stock prices are indeed affected by prevailing business conditions. Their findings showed that when the business climate was at a low point, increased dividend returns were expected in the market to shift income to investment, whereas lower dividend returns were needed and expected during a strong phase of the business cycle. The conclusion was that dividend yields could be used to determine stock prices.

Gan et al. (2006) looked at the relationship between the New Zealand Stock Index and a set of macroeconomic variables from January 1990 to January 2003. They used the Johansen cointegration test in a VECM to identify the relationship between the Share Price Index, inflation rate, exchange rate, gross domestic product, money supply, long- and short-term interest rates and the domestic retail oil price. They found that only interest rates, money supply and real GDP had consistent cointegrating relationships with the stock price index.

Further studies by Ansotegui and Esteban (2002), Hondroyiannis and Papapetrou (2001), and Lee (1992) all found cointegrating relationships between macroeconomic variables and stock prices by using multivariate Johansen Cointegration approaches. A lack of recent empirical evidence on developed markets in the light of the global economic upheaval in the last decade motivates studies which seek to both update the datasets being used as well as encompassing a larger horizon of analysis.

2.3 Emerging market evidence

Work done in emerging markets, such as that of Moolman and du Toit (2005), demonstrates the importance of research into the interaction between domestic macroeconomic factors and stock market performance in countries with developed financial markets, as strong relationships between changing trends in the financial markets and movements in macroeconomic variables are indicated. Bilson, Brailsford and Hooper (2001:424) provide strong evidence for the relationship between macroeconomic variables and expected stock returns, emphasising that emerging markets are especially dependent on domestic (as opposed to global) influences on the returns to stocks, even when the emerging markets are open economies.

Maysami, Howe and Hamzah (2004) explored the co-integrating evidence of macroeconomic variables to stock market indices in Singapore, and highlighted an area of deficiency in the global body of research as being the lack of a sector-by-sector analysis. The Composite Index of Singapore was broken down to analyse the effects of macroeconomic factors on the All-Share as well as the financial, property and hotel indices. It was concluded that the All-Share Index and property index had a cointegrating relationship with the macroeconomic variables of short-term interest rates (represented by the three-month interbank offer rate), long-term interest rates (represented by the month-end yield on one-year interbank rates), industrial production, consumer price index, exchange rate, and money supply (given as M2). Both the All-Share Equities Index and Property Index had positive relationships with money supply, inflation, industrial production and short term interest rates, while negative relationships were found with long-term interest rates and exchange rates. The Financial Index did not form a significant relationship with real economic activity or money supply, but is significantly affected by inflation, the exchange rate and both short- and long-term interest rates. Inflation and short-term interest rates formed a positive relationship with the index, while exchange rates and long-term interest rates formed a negative relationship. The Hotel Index failed to form significant relationships with short- or long-term interest rates or money supply, but formed positive relationships with exchange rates and industrial production.

Islam and Watanapalachaikul (2003) also tested for a relationship between stock exchange returns in Thailand (for the period 1992–2001) and macroeconomic factors such as interest rate, exchange rate, consumer price index and the bond price. They found a significant long run relationship between these factors and prices on the stock market.

Kwon and Shin (1999) investigated the relationship between economic activity and stock market returns in Korea using cointegration and Granger causality testing from a Vector Error Correction Model (VECM). The study found that stock price indices were affected by macroeconomic variables, namely the production index, exchange rate, trade balance, and money supply. The research pointed out, however, that changes in stock prices lagged behind movements in the macroeconomic variables even though they were linked.

Gunasekarage, Pisedtasalasai and Power (2004) tested the co-integrating long-term relationship between the All-Share Index (representing stock returns), the treasury bill rate (a proxy for interest rates), the consumer price index (representing inflation), and the exchange rate for Sri Lanka. The period from January 1985 to December 2001 was analysed using the Johansen test for co-integrating vectors as well as the subsequent VECM to test the long-term relationship between the macroeconomic variables and the stock market returns. Their analysis provided evidence that the lagged values of the consumer price index, money supply and treasury bill rate had a significant effect on the All-Share Index.

Maysami and Sim (2001a) also utilised the VECM technique to determine the relationship between macroeconomic variables and stock returns in Malaysia and Thailand. It was found that the effect of interest rates, inflation, money supply, exchange rates, as well as real activity had a confirmable effect on the stock market indices analysed. An analysis of Hong Kong and Singapore (Maysami and Sim, 2002b), and Japan and Korea (Maysami and Sim, 2001b)

produced similar results, namely that interest rates, inflation, money supply, exchange rate and real economic activity had an effect on stock market returns.

Nishat (2005) examines the affect that macroeconomic factors have on the Karachi Stock Exchange Index in Pakistan. Industrial production index, consumer price index, money supply (M1), and the money market rate (short-term interest rate) are examined for relationships with the stock exchange index using a VECM model for the data from January 1973 to April 2004. All variables were found to have a significant cointegrating relationship with the stock market. Industrial production was found to have the largest positive influence on the stock market, while inflation affected the stock market in the most negative influence. It was also found that macroeconomic variables Granger cause stock price movements with significant lag lengths between the fluctuations in the stock market and the real economy being applicable in the short term.

Vuyyuri (2005) examined the link between the interest rates for macroeconomic variables, inflation and the exchange rate and stock market returns for India. A strong co-integrating relationship between these macroeconomic variables and stock market returns was found.

Adam and Tweneboah (2008:14) examined the influence that macroeconomic variables had on the Ghanaian stock market (represented by the Databank Stock Index). They concluded that the stock market in Ghana was significantly influenced by macroeconomic forces such as the interest rate, inflation, foreign direct investment and the exchange rate. The results of the cointegration test showed that treasury bills (the proxy for short-term interest rates) had a negative and significant relationship to stock price returns, while foreign direct investment had a positive and significant relationship. Inflation and exchange rates have a negative but insignificant relationship to stock market returns. The gap in this research is highlighted in the narrow market study that was performed; a broader sectoral study may well have presented contrasting results.

Samitas (2008) looks at the explanatory power that macroeconomic variables have over stock prices in developing European countries like Poland, the Czech Republic, Slovakia and Hungary on the one hand, and developed European countries like the United Kingdom, France, Italy and Germany on the other. They tested the relationships between share prices, industrial production in the US, domestic industrial production, interest rates in the US and domestic interest rates using cointegration theory. The results from the VECM found that interest rates had a significant relationship with all countries' share prices, while domestic industrial production was found to have a significant effect only on developing European countries' share prices. Generally they found domestic industrial production to carry a stronger effect than domestic interest rates, while share prices in all countries were more affected by US interest rates than by US industrial production.

Horobet (2008) examined the relationship between macroeconomic variables and stock prices for countries in Central and Eastern Europe from January 1998 to September 2007. Johansen cointegration and Granger causality tests were used to determine if stock prices were affected by GDP, inflation (CPI), money supply, interest rates and the real exchange rate. Inflation (represented by the consumer price index) had a positive relationship, while real exchange rate was negative for all countries within the study with the exception of Romania. Real interest rates for Poland, Romania and the Czech Republic were found to all be positively related to stock prices. GDP and money supply were found to have a positive relationship in the long run with stock prices for all countries in the study.

Rahman (2009) looks at the interactions between selected macroeconomic variables and stock prices for Malaysia. The Johansen cointegration and VECM method were used to determine an outcome. It was found that changes in money supply, interest rates, exchange rates, domestic reserves and the industrial production index all had a significant relationship to stock price movements in Malaysia. Furthermore, it was shown through variance decomposition that the Malaysian stock market has far stronger interactions with reserves and the industrial production index than it does with money supply, interest rates or the exchange rate.

Frimpong (2009) considers the linkages between macroeconomic factors and stock returns for Ghana from November 1990 to December 2006. The Johansen cointegration method was used to determine the relationship between exchange rates, inflation (CPI), money supply, interest rates and stock prices on the Ghana Stock Exchange. The findings were that all the macroeconomic factors (with the exception of exchange rate) had a negative impact on stock prices.

Developing economies have a far more recent timeline of analysis, however, few studies look at any form of market segmentation or the effects macroeconomic forces have on different sectors of the stock market. This then further motivates the need for more studies that delve deeper into market structure to determine the possible different effects of macroeconomic changes on the different sectors of the economy.

2.4 South African Evidence

Van Rensburg (1998) in an examination of the Gold Index and the Industrial Index separately from the ASI on the JSE. Found that the Gold Index was influenced by the Gold price as well as the rand/dollar exchange rate. The Industrial Index was influenced by the Dow Jones Industrial Index and domestic short term interest rates.

Jefferis et al. (2000:39) studied the effect of macroeconomic factors (real domestic long-term interest rates, US interest rates, real exchange rate, and real domestic GDP) on stock market returns in the context of Southern Africa, with South Africa falling into this study. The findings for the study (conducted from 1985–1995) concluded that these macroeconomic variables all had an impact on stock returns in South Africa. The results also indicated that these changes only had an effect after lags of three quarters and as such may suggest a more indirect effect as opposed to a direct influence on the stock market.

Coetzee (2002) used monetary variables as macroeconomic factors to test for a relationship between these and stock prices in South Africa from 1991 to 2001. Using the Johansen Cointegration approach a negative relationship was found between stock prices on the ASI and the variables, rand/dollar exchange rate, inflation and short-term interest rates in both the long- and short-term for all variables. Stock prices were also found to be negatively impacted by downturns in the economy, as well as being positively boosted during periods of strong economic growth.

Khamfula (2004:12) explored the idea that economic growth in South Africa is determined mainly by movements in real effective exchange rates, domestic inflation, nominal money supply and nominal interest rates. The macroeconomic factors identified are helpful in analysing those variables that cause economic growth, and should consequently have a strong effect on stock market returns. The main emphasis of the research, however, is on the effects and policy implications of the Growth, Employment and Redistribution (GEAR) macroeconomic strategy in South Africa. This required investigating whether nominal interest rate, corporate income tax, money supply, domestic savings and imports have a determining influence on economic growth in South Africa. Total mining production, and total government expenditure were seen to have no influence on economic growth.

Olalere (2006) investigated the relationship between macroeconomic variables and stock market behaviour proxied by share prices and market capitalisation on the JSE from 1990 to 2004. Using the Johansen and Juselius (1990) cointegration and vector error correction technique it was found that inflation had a significant negative impact on share prices, while long term interest rates – specifically the yield on long-term government bonds – positively determined market capitalisation. Exchange rate was found to have no significant effect on share prices, but had a significant and negative impact on market capitalisation. The yield on long term US government bonds was found to have a significant negative impact on share prices in South Africa, while it had a positive impact on domestic market capitalisation. A further important finding of the study

was that, when it came to explaining changes in market capitalisation and movements in share prices, US interest rates had a greater effect on the South African stock market than South Africa's own domestic interest rates. Finally, GDP was found to have a stronger positive effect on stock market prices than it did on market capitalisation.

Moolman and du Toit (2005) approached the relationship of the JSE to macro-economic variables by developing an error correction model to describe the movements in the market that would occur given a shift in the selected variables. To this end a structural model was developed and estimated, showing the existence of a relationship between macro variables and stock price movements in the model. The research showed that the contagion effect of international markets did not hold sway over the South African market and domestic factors were found to be the main determining factor over long-term intrinsic market value. It was put forward that long term share prices were determined by discounted future dividends, while short-term movements were caused by interest rates, the rand/dollar exchange rate, S&P 500 Index, gold price and a change in the risk premium. Though the S&P 500 and gold price are globally determined measures, external to the influence of the South African market, the effect they have on the South African markets and investor confidence levels is palpable and they thus have an influence on market movements in the short-term, but have no long-term influence.

The conclusions drawn from the review of empirical literature provide a compelling case for further research into the impact that domestic macroeconomic factors, specifically those identified in the studies consulted (interest rates, inflation, money supply and exchange rate) have an effect on stock market sectoral indices. Understanding these important links will allow for more accurate modelling of the stock market as well as sectoral movements, allowing for a greater understanding and reduced volatility induced by irrational behaviour in the market. This added volatility stems from adverse and reactionary movements in investor buy/sell decisions caused by a lack of clear understanding of the links between expected share-price movements and macroeconomic factors which should not add to volatility, while unexpected movements should. In the South African context only a sparse amount of analysis has been conducted with

regard to sectoral indices of the stock market. An understanding of how macroeconomic forces can affect the various sectors of the market will therefore contribute towards a body of research that remains thin in South Africa. These relationships, once established, should provide insight into the interactions that exist within the sub-sectors of the South African financial markets and enable greater understanding and forecasting of market performance based upon macroeconomic trends in interest rates, inflation, money supply and the rand/dollar exchange rate.

South African research examined above highlights both the need for a look at sectoral effects of macroeconomic factors within the economy as well as the inclusion of a post-Apartheid economic reintegration timeline of analysis. As such this study provides the longest and most recent period of post-Apartheid analysis of macroeconomic forces on the South African market as well as being the first study within South Africa to examine the impact of macroeconomic variables of a wide range of Economic sectors in the South African economy as reflected in stock market indices for these sectors.

This chapter has presented theoretical and empirical evidence supporting the relationships found between macroeconomic variables and stock market prices. Macroeconomic variables identified in the literature to be significant which are used in this study are money supply, inflation, long- and short-term interest rates, and the exchange rate. This chapter has also supported the method of research that will be employed to identify whether cointegrating relationships exist between the macroeconomic variables and stock market indices in South Africa. As such, Johansen cointegration and VECM modelling are conducted in Chapter Four of this thesis. A follow-up is then conducted using Impulse Response and Variance Decomposition tests.

A summary of the empirical papers reviewed in this study can be found in Appendix 2. The next chapter presents a brief review of events and factors that influenced macroeconomic variables in South Africa during the period being examined.

Chapter 3: Summary of Macroeconomic Developments in South Africa from 1996–2008

This chapter provides a brief review of South African macroeconomic developments over the study period to put into perspective both the global and domestic events that shaped the economic climate during the period 1996–2008 which saw the re-emergence of South Africa into the global market post the Apartheid era. An understanding of the links between macroeconomic variables and the economy as a whole which are to be used to gauge their impact on the South African stock market can be gained from this review.

3.1 Chronology of macroeconomic events

In 1996 the economy of South Africa entered a downward phase of the business cycle. Heavy household indebtedness, a high M2 growth rate and bank credit extension, led to a persisting situation of inflationary pressure and a prevention of relaxation of tight macroeconomic policy. The relaxation of foreign exchange controls and the opening up of the South African investment market to the global community after 1994 allowed for a large amount of foreign capital to enter the South African equity market. In February 1996, with a weakening of the rand under inflationary pressures and speculative fears that the rand was overvalued (Hirsch, 2005), there was a reduction of capital inflows from abroad into the market. Some of this lost foreign revenue was regained through a strengthening of exports from base minerals during this period. The uncertainty in the South African foreign exchange market and the sharp depreciation of the rand from the middle of February 1996 caused large outflows of speculative capital during March and April of 1996. To counter this, the South African Reserve Bank (SARB) sold a substantial amount of foreign exchange into the market during March. This was to provide for balance-of-

payments requirements, as well as to smooth the downward trend of the rand. The outflow of funds from the market thus drained liquidity and therefore increased the rate of accommodation needed by banks. The effect of this was increased pressure for money market interest rates to increase. The South African Reserve Bank adopted a more restrictive monetary policy to counter the strong growth in money supply as well as credit extension that, coupled with a strong domestic growth for consumer and capital goods, was leading to mounting inflationary pressures (South African Reserve Bank, 1996).

Though at the start of 1997 the rate of economic growth had slowed, the economy was nonetheless still expanding. Continued adherence to a counter-inflationary monetary policy had encouraged a declining CPI, which had been helped to some extent by a stronger rand from January 1997, coupled with declining oil prices and a slowdown of domestic consumer demand. Stable foreign exchange rates in the market led to a stronger foreign investment flow into the South African Bond and Equity markets. The foreign investment had help to provide for a favourable balance of payments surplus causing the rand to strengthen slightly during the first quarter of 1997. In 1997 SARB reversed the position it had held in 1996 and now became a net buyer of foreign exchange. Credit extension and continued growth of money supply despite higher interest rates accelerated during the first two quarters of 1997. Though inflationary pressures and foreign investment concerns had resulted in higher interest rates during the end of 1996, this position was reversed during the first half of 1997 as investor sentiment changed and the rand strengthened. Liquidity shortfalls that had caused the higher money market rates during 1996 were eased in 1997 as a stronger provision of market liquidity by foreign investment led to increased capital across the South African markets (Aron et al., 2009). The notable exception here was the Mining sector which experienced a continued downturn from May 1996 to June 1997, despite the favourable market considerations for the South African economy overall with the All-Share Index having a new high in June 1997. Gold production was at a 40-year low during 1997 as the gold price fell to further lows during the course of the year (South African Reserve Bank, 1997).

Though the South African market had escaped the Asian Financial crisis of 1997 without any long-term effects during 1997, in the second quarter of 1998 a second round of financial shocks from the Asian crisis, namely the default by Russia on its debt, had a marked effect on the South African economy. By May 1998 the easing of monetary conditions from October 1997 to March 1998 had been reversed. Despite this, inflation continued to decrease throughout 1998 due to a continued slowdown in consumer demand (South African Reserve Bank, 1998). Relaxations on exchange controls on South African residents, as well as an inflow of foreign investment, helped support the rand in the first quarter of 1998 as a more liberal financial system buoyed investor considerations. By the end of the second quarter, the financial crisis had a renewed, secondary and more lasting effect on the South African economy. A sharp reduction in foreign investment led to a rapid depreciation of the rand (Hirsch, 2005). During this time money supply and credit extension to the private sector continued to grow. This, aided by a continued decrease in inflation and inflationary expectations, led to falling long- and short-term interest rates during the first half of 1998. This situation was not allowed to continue, however, as by the end of the second quarter in 1998 the Asia crisis effect had forced SARB to drastically tighten monetary policy and liquidity conditions. The reduced liquidity environment forced the rates of interest in the market to rapidly peak to 25.5% for the prime overdraft rate. SARB was forced to sell off large parts of its foreign exchange reserves so as to insulate the rand from further rapid depreciation (South African Reserve Bank, 1998).

By 1999 the South African markets had taken a strong hit from the instability caused by the Asian crisis and the worsening Russian economic climate. Developing markets were seen as far riskier option after the 1997–1998 crisis period. The aftermath of 1998 on the South African economy was a drastically slowed rate of domestic production and consumption. This led to a slowdown in money-supply growth as well as credit extension to corporate borrowers. The export market had lost a large measure of external demand in addition to the domestic market's slowdown in demand (Aron et al., 2009). The rapidly increased domestic interest rates that had aided economic stability during the crisis period in 1998 were now allowed to fall back to their previous lower levels as the outlook for macroeconomic stability was positive. Both long- and short-term interest rates fell back to levels lower than their pre-1997 crisis positions, while bond

rates incorporated a slightly higher rate of return due to the added risk premium assigned to developing markets following the Asian crisis. The easing of market interest rates and a stable economic outlook enabled the South African stock and bond markets to recover by the end of June 1999 (South African Reserve Bank, 1999).

In 2000 the South African markets, as well as global markets, had recovered from the previous years of financial crisis. Rising oil prices, a weaker rand and food shortages all combined during the first two quarters of 2000 to push inflation higher. This was consistent with the global trend, but South Africa managed to weather most of this inflationary pressure due to a still evident slowdown in consumer demand coupled with a reduction in the extent of credit growth. In the second quarter of 2000 there was again a large outflow of foreign capital from the bond market. This led to a weakening of the rand in the first half of 2000 as global fears over African economies led to speculative withdrawals. Bond yields as a result of this were seen to rapidly increase as investor sentiment turned against South Africa, while domestic fears over increasing money market interest rates caused share prices to fall until May. Though the markets recovered from June, there was still an imbalance present in monetary aggregates as investors were apprehensive about the future performance of the South African economy and investors preferred holding short-term instruments. This short-term view was confirmed late in 2000 by unfavourable developments in the US economy, namely the bursting of the “dot com” bubble which saw an extensive global turndown of foreign investment and US demand for goods, leading to a suppressed global economy (South African Reserve Bank, 2000).

By 2001 a looming recession on the back of the ‘dot com’ collapse in the US forced the Federal Reserve to strongly cut interest rates, while global trading partners also eased up on monetary policy to avert a recession. A weakened rand led to a healthy gain in gold price as well as South African export earnings. The rand devaluation during this period was attributed to global market factors external to the South African market that affected the level of foreign capital inflows. Increased household confidence in the latter half of 2001 led to an increase in the rate of credit extension as well as broader aggregates of money supply. An easing of market regulations and a

reduction in borrowing requirements allowed the price of bonds to have marked gains from May 2001. Consequently, a strong fall in bond yields occurred during this period. Foreign investors were hesitant as to the outlook of a possible weakening rand and thus did not take advantage of the appreciating bond prices. Despite this, large foreign purchases of South African equities did occur (Hirsch, 2005). The terrorist attacks in September 2001 caused a large reduction in global trade as future economic activity became volatile and uncertain. This further reduction in global investor confidence substantially reduced not only foreign investment but also foreign final good production (South African Reserve Bank, 2001).

2002 brought with it a regained strengthening of the rand in the first quarter due to a growing balance of payments surplus. Large foreign capital inflows were seen particularly from the restructuring between the Anglo-American Corporation and De Beers (South African Reserve Bank, 2002). During the first half of 2002 the SARB reacted to increasing fears of inflationary pressure and adjusted the repo rate upwards by 3%. The market uncertainty that had persisted throughout 2001 had added higher risk premia to long bond market rates. This effect lasted through the first quarter of 2002 but then began to abate, leading to a lessening of long-term rates. In the first two quarters of 2002 the share market in South Africa surged on the back of expectations of imminent economic recovery. The mining sector in particular reaped the benefits of increased returns from a weakened rand during this period. 2002, however, saw South Africa's first recorded full year balance of payments surplus, though most gains on the current and capital accounts came from the first half of the year (Hirsch, 2005). A rapid recovery of the rand late in 2002 led to decline in the share market. This was then accentuated by a weak outlook on future profitability and slow global economic growth (South African Reserve Bank, 2002).

2003 opened with renewed global market uncertainty. In March the war in Iraq and an outbreak of Severe Acute Respiratory Syndrome depressed the outlook for global commerce. To counter this, most world economies began a process of fiscal and monetary policy stimulation to help stimulate economic growth. In South Africa, GDP slowed with both the manufacturing and primary sectors of the economy having substantial slowdowns in output. Increased extension in

bank credit underpinned household expenditure and propped up domestic demand. Inflation was still pervasive in the economy as it trended outside the target band through 2003. Tighter monetary controls and a brief recovery in the strength of the rand allowed services prices to stabilise CPIX but production-based inflation was still higher than target due to the previous weakened rand position as well as record high oil prices. The current account surplus which had persisted though 2002 turned to a deficit by the second quarter of 2003 as sluggish exports were attributed to a weak demand for goods globally. Continued targeting of inflation, and therefore higher interest rates, had led to a slowdown in the growth of monetary aggregates along with a significant decrease in real income within the economy. By August 2003 SARB once again began easing its tight control on monetary policy and reduced interest rates. This resulted in a rapid decline in market rates and the return of a normal yield curve for long-term bonds. 2003 was marked by strong negative sentiments towards investment in foreign markets and saw the South African markets lose out on foreign investment inflows (South African Reserve Bank, 2003).

2004 saw a resurgence of the South African economy with low interest rates and firm commodity and export prices. This resurgence was further supported by expansive fiscal policy and strong consumer confidence. Growth in real output led to gains across all market sectors in the first half of 2004 (Rodik, 2006). During the first half of the year South Africa's imports grew far faster than exports to the extent that the balance of payments deficit widened, but gains from the commodity price boom and favourable foreign capital inflows helped to strengthen the rand's position (Aron et al., 2009). Broad money rates growth in 2004 receded slightly on the back of lower inflationary pressures, though it should be noted that there was a large growth in long-term loan extensions to the private sector as capital and housing investment expansion continued (Frankel, 2007). The beginning of 2004 saw the share market prices falling back from 2003 levels as an adverse strengthening of the exchange rate saw a reduction in foreign investment. The lower inflationary environment, coupled with a strengthened rand, also caused a reduction in bond yields as inflationary expectations abated. Thus, 2004 marked the start of a period of exceptionally low rates of interest in the market (South African Reserve Bank, 2004).

In 2005 low global short-term interest rates resulted in a surge in global liquidity, rapid credit expansion as well as investment into the global shares markets. The downside of such easy borrowing was that riskier participants were now able to enter the market much more easily than before. 2005 also experienced a drastic increase in the cost of crude oil up until August, while all other commodity prices experienced a smaller boom. Rising income levels in the South African economy, spurred on by low interest rates, led to rapid expansion into capital investment (Frankel, 2007). The resulting appreciation in the housing market supported strong growth in various related sectors of the economy. 2005 therefore marked the start of South Africa's runaway credit expansion and high consumer debt phase as low interest rates left debt service levels relatively low and affordable (Aron et al., 2009). To support this rapid expansion in aggregate expenditure and growth in nominal income, money supply expanded strongly. Prices in the local financial markets boomed as the exchange rate for the rand appreciated strongly and inflationary concerns were well in check. Yields on long-term bonds thus attained all-time lows by February. The share market was supported strongly and hit all-time highs during August 2005 on the back of positive investor sentiment. Thus, 2005 once again characterised a boom year for South Africa as strong commodity and domestic housing prices, a firm rand, and positive investor sentiment drove wealth and positive turnover in the South African financial markets (South African Reserve Bank, 2005).

In the first half of 2006 the current account deficit widened to greater than 6% of GDP by June. The release of these figures caused a strong depreciation of the rand combined with a withdrawal of foreign investors from the market from May onwards as they sought to lessen emerging market exposure globally. The capital account was, however, supported by strong foreign investment during the year to reverse most of the earlier currency depreciation. Barclays Bank's acquisition of a controlling interest in ABSA as well as Vodafone's buyout of an interest in Vodacom both acted to substantially boost foreign capital inflows into the South African market. Consequently, the first four months of 2006 saw strong gains on the share market as commodity and share prices rose. From May to July investor sentiment turned against emerging markets but soon recovered when bond yields rose to support falling market prices and encouraged a buyback of investment in South African bonds (Aron et al., 2009). The Monetary Policy Committee

(MPC) of SARB decided to increase the repo rate in June and again in August to bring inflationary pressures under control. The effect was a marked rise in all market-related interest rates and a withdrawal of liquidity from the money market. Strong performance and gains made by assets during 2006 had significant wealth effects and drove large increases in money supply. Bank credit extension to private households also expanded further to meet the growing demand for money. 2006 therefore marked a strong year for South Africa in economic growth. High commodity and asset prices contributed to the wealth effect and put strong inflationary pressure on the domestic economy. SARB reacted to this accordingly by adjusting interest rates upwards in the market (South African Reserve Bank, 2006).

A period of turmoil in the South African market followed in 2007. High global oil and food prices contributed to a period of rising inflationary pressure on the South African market. The first half of 2007 was still characterised by a healthy balance of payments position funded by large foreign investment in the share market. The Monetary Policy Committee's movement in 2007 to further adjust the repurchase rate upwards had the effect of raising the yield on bonds. Gains on the South African markets were seen until August 2007 when the sub-prime crisis in the global markets had a ripple effect on the domestic market (Aron et al., 2009). Global investor exposure to losses on the mortgage market in the US caused a drastic reduction on available global liquidity to the financial markets. This, coupled with increasing inflationary pressures, caused local interest rates to be ratcheted up drastically. The result of large increases in interest rates due to lowered liquidity as well as the events in global financial markets was a steep fall in share market prices. Higher yields on long term bonds were however not met with renewed investor interest as the period following August was met with a severe reduction of market liquidity coupled with a withdrawal of foreign investor exposure to emerging markets (South African Reserve Bank, 2007).

2008 was one of South Africa's hardest financial years on recent record. Runaway inflation (fuelled by high energy and food costs) and a severe shortage of electricity power supply, combined domestically with ongoing global financial market instability, had a severely negative

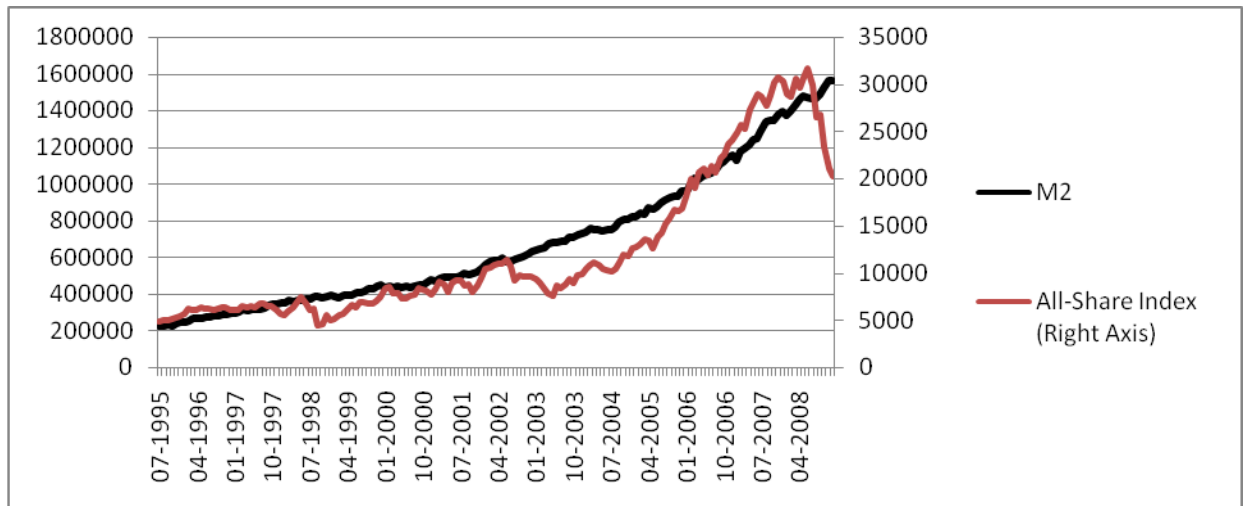
effect on South Africa. Export demand globally was down and large outflows of foreign capital and a growing balance of payments deficit left the rand in an untenable situation and it depreciated rapidly. This worsened the inflationary pressures on the economy as energy and import prices soared. Tight monetary policy concerns from 2007 continued into 2008 with further increases in the repurchase rate. By the second half of 2008 commodity prices had begun to fall rapidly as global demand was drastically reduced. The failure of a major bank in September 2008 fuelled concerns of further economic stability, and a global recession was entered into quickly.

The second half of 2008 was thus characterised by declining inflationary pressure and the start of much lower interest rates (in an attempt to boost flagging economies and prop up the global financial institutions). South African exports retracted drastically and the balance of payments gap widened. The large lack of market liquidity and global recession impacted negatively on the domestic share and fixed asset markets. Rapidly decreasing asset prices were matched by a strong decline in monetary aggregate growth as the economy fell into the first recession since 1993. The intensification of the financial crisis added measurably to the risk aversion of foreign investors who withdrew money from the South African economy rapidly during the second half of 2008. This caused a further depreciation of the rand exchange rate. The financial infrastructure in South Africa remained unharmed by global turmoil as strict regulation and tight monetary adherence in previous years had insulated it from sub-prime fallout. 2008 ended on a background of inflationary pressures still evident on the domestic economy, a global recession and a severely weakened rand. High interest rates, put in place to control inflationary pressures, were questioned as the country headed further into the recession. Any recovery was further constrained by a lockdown on credit availability. The result saw all sectors of the South African economy weakening and a severe lack of market liquidity moving into 2009 (South African Reserve Bank, 2008).

3.2 Changes in macroeconomic variables

Having discussed the flow of variables and events within the South African macroeconomy between 1996 and 2008, let me now turn to a brief look at the macroeconomic variables selected for this study.

Figure 1: Money Supply vs ASI



As can be noted from Figure 1, money supply has continued to grow at a steady state during the period of this study. Assisted by a steady rate of economic growth the supply of money in the economy has kept up and assisted economic as well as stock market growth between July 1995 and December 2008. Visually, the slowdown in the ASI from April 2002 appears unrelated to any change in money supply. Likewise, the sharp fall in the share market in 2008 seems not to be related to changes in money supply. However, in the models developed and discussed in subsequent chapters, the logarithms of money supply are correlated with the stock market indices to see whether there are relationships between their rates of growth that are not visible graphically in their non-logged forms.

Figure 2: Rand/USD Exchange Rate vs ASI

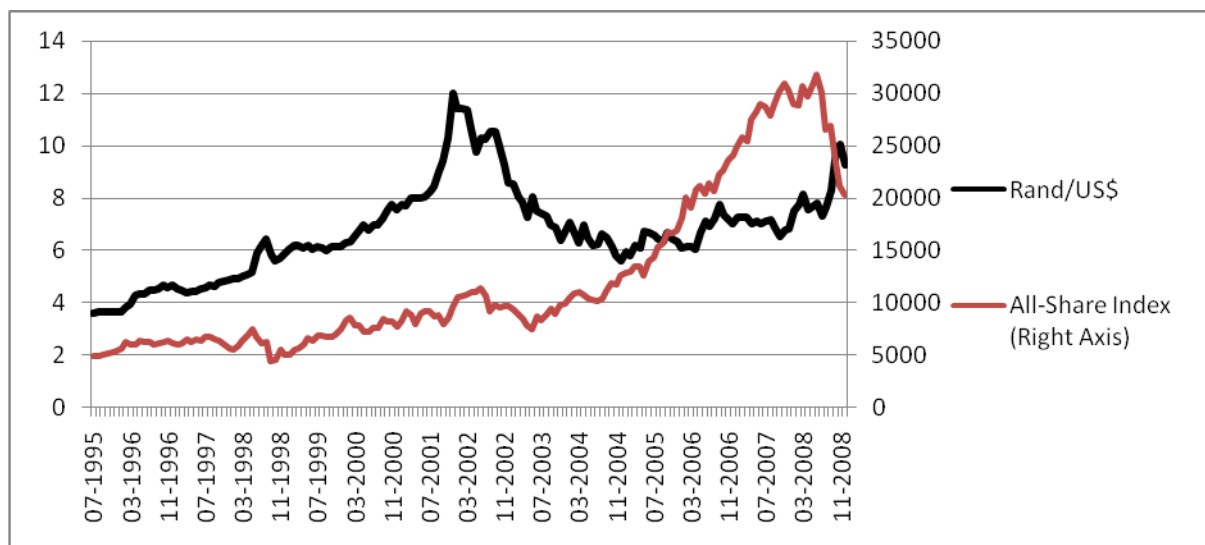
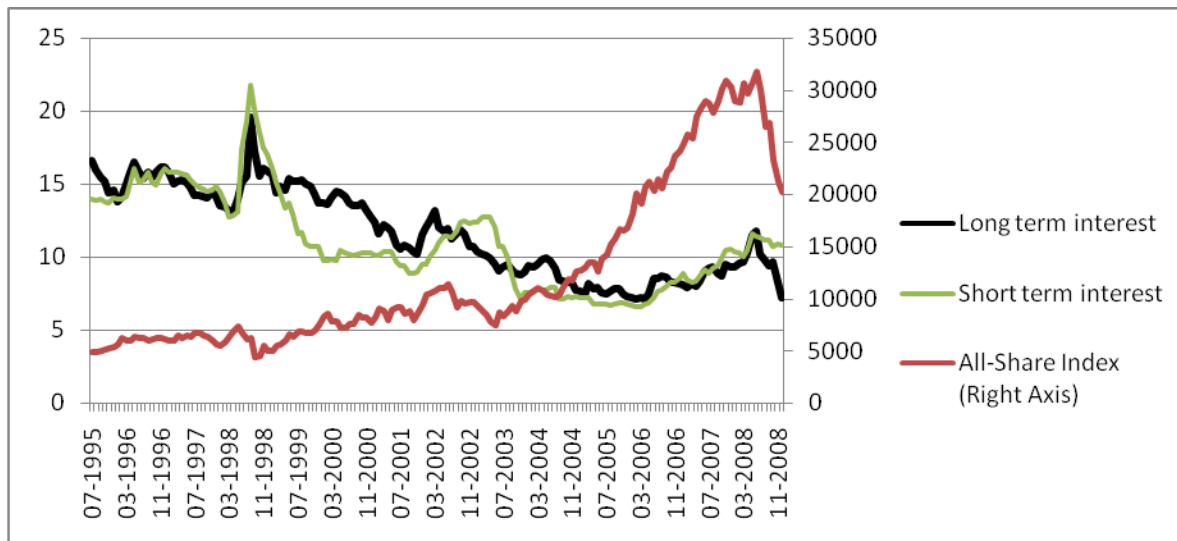


Figure 2 presents a strong visual reference to the fluctuations and shock depreciations that occurred in the rand over the course of this study. It should be remembered that a rise in the rand/dollar exchange rate represents a weakening of the exchange rate. From mid-1998 the rand depreciated sharply against the dollar as the second round of shocks from the East Asian and Russian debt crises affected developing markets. The sale of a large number of South Africa's foreign reserves and a sharp rise in short-term interest rates (Figure 3) during this period failed to stabilise the shocks to the currency in 1998. This downward trend in the value of the rand continued until the September 11 attacks of 2001 in the US which, combined with fallout from the 'Dot com' crisis, forced global markets into a panic and caused a further sharp depreciation in the rand/dollar value at the end of 2001. A favourable balance of payments situation in late 2002 (as a result of firming commodity prices and substantial foreign capital inflows into the South African equity markets) boosted a recovery of the rand. The rand/dollar exchange rate subsequently recovered, strengthening to its pre-2001 levels by 2004 and remained at around this level until mid-2008 when the global financial crisis caused a sharp weakening.

Visually, the period of rand/dollar strength after 2003 appears to coincide with a strongly rising ASI, while the sharp fall in the rand/dollar in late 2008 coincides with a significant fall of the ASI. Rand/dollar weakness in 1998 and 2001 coincides with a falling stock market, but the gradually weaker rand from 1999–2001 coincides with a slowing down of the rising ASI.

Figure 3: Long/Short-Term Interest Rates vs ASI

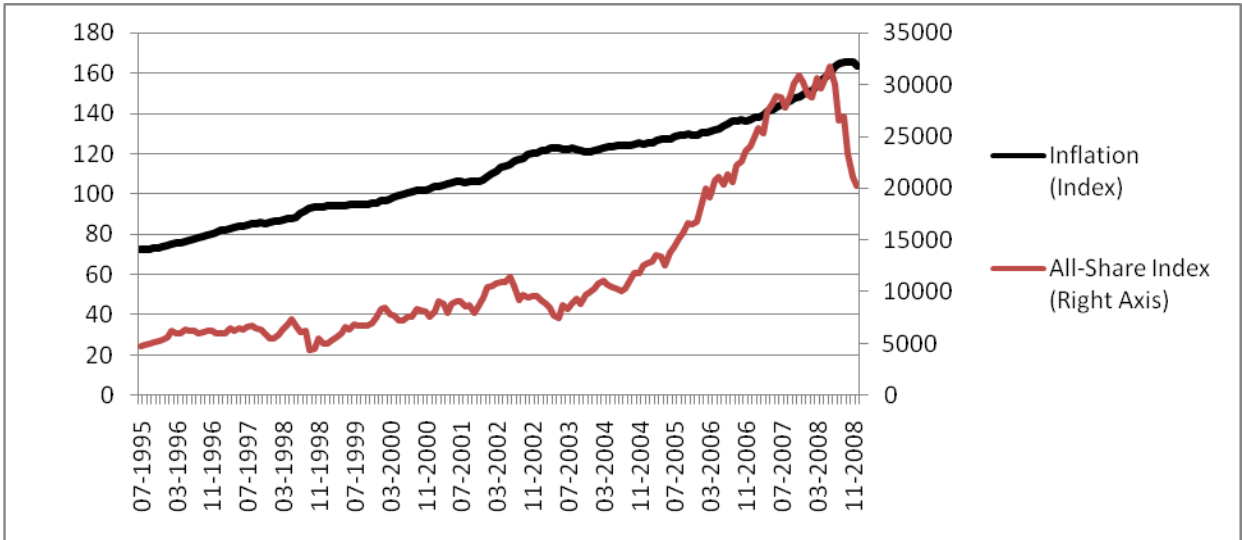


The long and short term interest rate behaviour in South Africa for July 1995 to December 2008 can be seen in Figure 3. During this period the high point to be noted was the effect the Asian crisis had on interest rates in South Africa in 1998. As stated previously, the crisis forced SARB to drastically increase interest rates to try to insulate the South African economy from further global economic fallout. The result was a record high 25.5% prime overdraft rate in South Africa. Tight monetary conditions were eased after 1998 and the general trend in interest rates is downward thereafter as the introduction of inflation targeting in 2002 gradually pushed inflation lower. During 2001–2002 the global ‘Dot com’ crisis and US ‘War on Terror’ caused another round of global market shocks. SARB again sought to protect the domestic economy by tightening monetary policy, but interest rates were subsequently eased again during 2003 and remained low until 2006 when rising domestic inflation caused another round of interest rate tightening as higher global oil and food prices pushed inflation above the target range. Long-

term interest rates fell sharply towards the end of 2008, correctly anticipating the lower inflation and cuts in short term rates that started at the end of 2008. This continued apace in 2009 (not shown here) as the global financial crisis pushed oil prices much lower and domestic inflation started to fall.

Lower interest rates after 2002 appear (visually) to have coincided with the boom in the ASI after this period and the sharp rise in interest rates in 1998 coincided with a weak ASI. Higher interest rates in 2002 initially coincided with a stronger ASI, but the stock market declined later.

Figure 4: Inflation vs ASI



Consumer prices have risen steadily, more than doubling over the study period. Inflation in South Africa (measured by the 12-month rate of change in consumer prices) had managed to have a continued downward trend up until the global US economic crisis and in the terror attacks in the US in late 2001. The subsequent sharp jump in inflation was brought about by rapidly rising oil prices and the dramatic fall in the rand exchange rate (Figure 2) brought about by the withdrawal of foreign investment and fears of further global economic fallout. The subsequent strengthening of the rand exchange rate brought about a sharp decline in inflation. This period

also saw the adoption of inflation targeting as a policy framework for South Africa. During this period monetary aggregates and interest rates were controlled to keep inflationary pressures in check. Inflation remained (by South African standards) at quite modest levels until mid 2007 when global inflationary pressures and especially rising global oil and food prices pushed South African consumer price inflation significantly above the 6% inflation target ceiling. Inflation had already begun to decline when the global crisis impacted in late 2008 and thereafter was pushed lower by falling global oil prices whose impact more than offset the upward price pressures of a much weaker rand exchange rate.

The relationship between inflation and the Consumer Price Index is not obvious in Figure 4. However, (as with money supply) in the models developed and discussed in subsequent chapters the logarithms of the Consumer Price Index are correlated with the stock market indices to see whether there are relationships between their rates of growth that are not visible graphically in their non-logged forms.

Appendix 2 presents the figures for inflation, exchange rate, long- and short-term interest rates and money supply against each of the four indices examined in this study.

The following chapter presents the expected outcomes and *a priori* assumptions for the selected macroeconomic variables in this study. The empirical framework and method employed in this study are presented in depth. A description of the data and their consistencies is also laid out.

Chapter 4: Method and Description of Data

This chapter provides a description of the econometric techniques used as well as the expected outcomes for the macroeconomic variables and their interactions with stock prices in South Africa. The chapter concludes with a presentation of the consistency and description of the data collected for use in this study.

4.1 Hypothesised Variable Relationships

In this section we discuss the *a priori* relationships that are expected between the stock market indices and the macroeconomic factors that will be used in the model designed. The areas that will be covered in terms of macroeconomic variables are: interest rates (91-Day Treasury Bill), Consumer Price Inflation (CPI), exchange rates (nominal bilateral exchange rate), money supply (M2) and long-term interest rates (the yield on long-dated government bonds). The *a priori* effects of these macroeconomic variables on stock market returns will be discussed.

Interest rates are expected to have a negative relationship with stock market returns. The logic is that interest rates form a principal cost of borrowing for a company and as such when they decrease they will stimulate investment and reduce debt costs, and *vice-versa*. Maysami, Howe and Hamzah (2004) argue that the inverse relationship occurs because interest rates influence the level of business profits, thus raising investors' expectations over the stock price when interest rates fall as they expect higher dividends in the future as profits rise and the cost of a company's borrowed finance and capital expansion is cheaper to finance, thus freeing up liquidity. The relationship can be carried over to the private/speculative investor's perspective as well if we think of investment spending being financed by borrowed capital. A reduction in interest rates will make the cost of borrowed capital cheaper which would subsequently lead to investors

(private capital investors) buying more stocks as they need a lower return from investment to satisfy their investment function which in turn leads to an appreciation of price as stocks are bid up. The occurrence is due to the opportunity cost of holding equities becoming greater than the cost of borrowing. (Maysami, Howe and Hamzah 2004: 54).

Inflation can be seen to impact the share market in the effect that an increase in the rate of inflation will depress investment in the stock market. If this increase falls outside the band of inflation targeting, the Reserve Bank would accordingly adjust the repo rate upwards which leads through the transmission mechanism of the interest rate channel to an increase in the prime lending rate, thus reducing available liquidity in the money market.² The overall effect of this is an easing of inflationary pressure.

If, however, the inflation rate increases but does not exceed the target band, the outcome would be uncertain as the Reserve Bank would not adjust the repo rate and liquidity in the market may continue to grow unabated. Increasing inflation, as supported by economic theory, will cause asset prices to be eroded and lead to a decrease in investment in stocks as higher returns are needed by investors due to an increased cost in the rate of borrowing (i.e. an increase in the prime rate of lending). Fama and Schwert (1977) highlight these points towards this negative relationship between inflation and stock prices in their paper.

Exchange rate is expected to have a negative relationship with the stock price. This effect happens on two fronts. For investors, a weakening in the exchange rate makes it relatively cheaper for foreign investors to acquire equities and other assets in South Africa and increases their chances of significant capital gains if their returns are repatriated once the exchange rate strengthens again. This increase in foreign investment will increase the level of demand for the stocks in the market and, as such, share prices will appreciate, as concluded by Mukherjee and

² In South Africa inflation targeting is the monetary policy tool that is used to combat rising inflation.

Naka (1995). For local producers a weakening in the exchange rate will have a favourable effect on domestic exports as domestic goods become relatively cheaper to the foreign market and result in an increase in foreign earnings for the exporting country (Maysami, Howe and Hamzah 2004: 54). The success of exporting firms should draw higher stock returns and consequently more investors and greater stock prices. The mining industry, which sells commodities based on US dollar prices, will also show gains when the domestic exchange rate weakens as their domestic currency earnings will increase once converted from the US dollar denominated sales revenue. These earnings gains will show up as increased dividend returns based on a weakening exchange rate and, as the mining industry makes up a large portion of the JSE, and US dollar denominated commodities dominate the mining sector, this influence should be a strong causal one.

Friedman and Schwartz (1963 in Maysami, Howe and Hamzah 2004) show the relationship between money supply and stock returns to be a positive one. This was shown by developing a model that revealed increases in the money supply to be analogous to increases in aggregate demand with a resultant pressure on stock prices to rise. They saw this as occurring due to M2 growth which was expected to lead to excess liquidity in the market, thus leading to higher security prices as this excess liquidity was converted into assets. One cautionary note on this relationship is provided by Mukherjee and Naka (1995) who saw an increase in money supply as potentially leading to inflation, and consequently an increase in the prime rate of lending which would lead to stock prices falling as rising interest rates stifle demand in the market.

Thus there may appear to be a contradictory response in stock returns when inflation rises with stock returns increasing in some cases but decreasing in others as seen from the view of an aggregate demand response function in the equity markets. The *a priori* expectation of this paper for South Africa is that the sign of this variable will be dependent on the current level of inflation in the economy. To further explain this, assume the rate of inflation currently sits within the inflation targeting band. If the increase in money supply caused the rate of inflation (as measured by CPI) to shift up by an amount that allowed it to still remain within the target band, the result

would be a positive effect on stock returns as interest rates would not be adjusted upwards by the Reserve Bank and stock prices would benefit from the increase in aggregate demand. If, however, the increases in M2 lead to a significant movement in the CPI outside of its targeted bandwidth, the result on share price would be a decrease as interest rates would be adjusted upwards to return inflation to its target band. Consequently, any *a priori* expectation of the effect of inflation on stock returns should be treated with caution.

4.2 Empirical Framework

The series are first tested for unit root (a determination of whether they are individually stationary or not). Series that are non-stationary are likely to generate spurious regression results as they are only relevant for their own time periods and can thus not be used to generalise outcomes for future periods. The Augmented Dickey-Fuller (ADF) and the Kwiatkowski-Philips-Schmidt-Shin (KPSS) tests are used to test the stationarity of each stock market index and macroeconomic series. The ADF tests a null hypothesis that the series in question has a unit root and is thus non-stationary, whereas the KPSS test assumes the null hypothesis is that the series is stationary. Hence: for the ADF the rejection of the null hypothesis shows the series to not have a unit root and thus be stationary; the KPSS rejection of the null hypothesis would assume the series not to have a unit root and thus be non-stationary (Brooks 2002:367-275)

This paper makes use of the Johansen and Juselius (1990) procedure for identifying long run relationships amongst the variables in multivariate models. As a large number of variables is being included in the model, the possibility of multiple cointegrating vectors cannot be ruled out. As such, the Johansen technique is used since it accommodates the possibility of multiple cointegrating vectors (Brooks, 2002).

The Johansen procedure applies maximum likelihood to a VAR model (assuming that the errors are white noise [Maddala and Kim, 1998]). Following the practice in standard econometric literature, a typical VAR(k) model can be represented as:

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^k \Gamma_i \Delta X_{t-i} + \varepsilon_{kt} \quad (1)$$

where:

$X_t = (X_{1t}, X_{2t}, \dots)$ is an $n \times 1$ vector of I(1) variables, ΔX_t are all I(0), Γ_i are $n \times n$ coefficient matrices; ε_{kt} are normally and independently distributed error terms; and $\Pi = 0$ if there is no cointegration. (Π represents the matrix product.)

Since $\Delta X_t, \dots, \Delta X_{t-k+1}$ are all I(0) but X_t is I(1), in order for this to render an efficient equation, Π_i would not be of full rank. If the full rank is assumed as being n and its reduced rank thus r , if $r = n$, then all the variables present in X_t are thus I(0). If the rank of $\Pi_i = 0$ then there would be no cointegrating relationships present (Harris 1995:75).

Π_i has a reduced rank of $r \leq (n - 1)$, which can then in such a case be decomposed as follows;

$$\Pi_i = \alpha \beta' \quad (2)$$

where α is a $n \cdot$ matrix and β' is a $\cdot n$ matrix. Then $\beta' X_{t-1}$ are the cointegrated variables. β' is thus the matrix of coefficients of the cointegrating vectors. In other words, β' represents the long-run coefficients, and α is the interpretation of the matrix of error-correction terms.

Π_i is the long-run coefficient matrix. It is through the use of this matrix's eigenvalues that a rank (r), equal to its characteristic roots that differ from zero, can be used to ascertain the number of cointegrating vectors. To determine r , and thus the existence and number of cointegrating vectors, Johansen uses a trace test:

$$LR = T \sum_{i=r+1}^n \ln (1 - \lambda_i) \quad (3)$$

And a maximum eigenvalues test:

$$LR = T \ln (1 - \lambda_{r+1}) \quad (4)$$

Where λ_i is the i -th largest eigenvalue of the Π_i matrix in equation 2. The trace statistic consecutively tests the null hypothesis that the number of cointegrating relations is r against the alternative of k cointegrating relations, where k is the number of endogenous variables. The maximum eigenvalue test evaluates the null hypothesis that there are r cointegrating vectors against an alternative of $r + 1$ (Brooks, 2002).

Cointegration implies that series that are individually non-stationary may attain stationarity in a linear combination. Thus in the long run they would have an influential effect on each other such that if two or more variables in this study are cointegrated with one of the indices being tested it stands to reason that these variables move together in the long run and that one variable will predict another if a valid error-correcting representation exists.

The extension on this is that once the number of cointegrating vectors has been identified, a Vector Error Correction Model (VECM) can be estimated. This estimation is procedurally done by specifying the cointegrating vectors, then defining the underlying trend assumption in the data, followed by the normalisation of the VECM on the valid or true cointegrating relationships present in the system.

The VECM allows for the restriction of the long-run behaviour of endogenous variables so as to allow convergence on their cointegrating relationships, while allowing for any short run adjustments to continue in the system. The returned residual can then be tested for white noise to determine the validity of the VECM outcome (Johansen and Juselius 1990).

Impulse Response Modelling will also be carried out on the variables from the VECM. Impulse Response Modelling describes the effect of a unit shock to a variable in a system and its effective propagation over time. Thus, the long term effects of adjustments to variables contained within the system can be measured to determine the magnitude and length of any change within the system.

Variance Decomposition can then be carried out on the VECM results. Variance Decomposition shows the amount of information or the effect each variable has on the other variables in this model. It therefore helps explain the amount of forecast error variance that can be explained in one variable by inducing shocks to the other variables.

Mention should also be made here of the Weak Form Test for Exogeneity. The Exogeneity Test is able to show the degree of causality between the variables in a VAR. Thus this test enables the identification of the exogeneity or endogeneity of variables within the system. As such the endogenous variables present in the system are the candidates for normalisation within the VECM, and, if more than one endogenous variable is present in a VAR, this may lead to the identification of more than one cointegrating vector.

4.3 Data and Implications

The data used in this analysis is from DataStream and comprises 162 observations per series. The data series (starting in July 1995 and terminating in December 2008) are measured as monthly values. The series examined are the JSE/FTSE All-Share Price Index, JSE/FTSE General Retailers Price Index, JSE/FTSE Mining Price Index, and JSE/FTSE Financial Price Index. These represent the sectors of the South African stock market being analysed and comprise the bulk of the market capitalisation of the South African stock market over the period. The macroeconomic variables being used are also extracted from DataStream for the matching period and are: SA Money Supply M2 Current, South African rand to US dollar bilateral nominal exchange rate, SA Treasury Bill Rate 3Month (EP), SA Redemption Yield on

Long-Dated (Benchmark) Government Bond, SA CPI (Index, 1975=100). All these variables are expressed in log form. The codes for each of the respective variables or price indices are presented below.

Table 1: Variable Definitions

	M2	Exrate	Short-term interest rate
<i>name</i>	SA MONEY SUPPLY - M2 CURN	SA RAND TO US DOLLAR (nominal Bilateral rate)	SA TREASURY BILL RATE- 3 MONTH (EP)
<i>code</i>	SAM2....A	SAXRUSD.	SAGBILL3
	Long term interest rate		
<i>name</i>	SA REDEMPTION YIELD ON LONG- DATED(BENCHMARK)GOVERNMENT BOND		
<i>code</i>	SAGBOND.		
	Inflation	All-Share	Financial
<i>name</i>	SA CPI (Indexed)	FTSE/JSE ALL-SHARE - PRICE INDEX (~R)	FTSE/JSE FINANCIALS - PRICE INDEX (~R)
<i>code</i>		JSEOVER(PI)~R	JSEI1FN(PI)~R
	Mining	Retail	
<i>name</i>	FTSE/JSE MINING - PRICE INDEX (~R)	FTSE/JSE GEN RETAILERS - PRICE INDEX (~R)	
<i>code</i>	JSEI3MM(PI)~R	JSEI3GR(PI)~R	

As presented above, the FTSE/JSE Africa Index series are compiled to represent various economic groupings or sectors. As such the indices used in this study can be defined according to the FTSE/JSE to contain the following sub-sectors. The All-Share Index is representative of an index compiled from all economic groupings, their sectors and sub-sectors on the JSE Mainboard. The Mining Index falls within the resources economic group. It represents the mining sector and contains the sub-sectors: Coal, Gold Mining, Platinum, Mining, Finance, Diamond, Other Mineral Extractors and Mines. The Financial Index represents the entire economic group Financials, and thus contains all subsectors listed within the Bank, Insurance, Life Assurance, Investment Companies, Real Estate, Speciality and other Finance sectors. The Retail Price Index represents the General Retailers Sector of the Cyclical Services Economic group, and as such contains the subsectors: Discount & Super Stores & Warehouses, Retailers –

Ecommerce, Retailers – Hardlines, Retailers – Multi Department, Retailers – Soft goods (JSE). These are the stock market price indices that are analysed in the study as they are taken to represent key equity areas for investment in the market, as well as sectors or economic groupings that may have a marked reaction to shifts in any of the macroeconomic factors chosen for the analysis.

This chapter looked at the econometric method used in the study as well as providing a description of the process of derivation for the Johansen and Juselius (1990) cointegration technique. A description of the process of research was presented and the data collected for the macroeconomic variables and sectoral indices of the JSE was presented. The next chapter examines the empirical results from the econometric tests.

Chapter 5: Empirical Results

This chapter looks at the results from the econometric tests performed. Summarised results for the overall index equations are then presented followed by sector-specific results discussed for each macroeconomic variable in turn. The Impulse Response and Variance Decomposition test results are then presented and their outcomes discussed with reference to their magnitude and duration of effect on the sectoral indices.

5.1 Test for Stationarity

ADF and KPSS tests were performed for each series to establish whether each was stationary or not. The optimal results for the series to be stationary at first difference would thus be if the null hypothesis is rejected in the ADF and accepted in the KPSS in the table below.

Table 2: Stationarity Tests

	ADF		KPSS	
	<i>Level (t-stat; prob.)</i>	<i>1st Diff.</i>	<i>Level</i>	<i>1st Diff.</i>
FTSE_JSE_ASI	-0,87 (0,79)	-12,15 (0,00)	211,89 (0,00)	1,78 (0,08)
FTSE_JSE_FI	-1,81 (0,37)	-12,33 (0,00)	295,07 (0,00)	1,22 (0,23)
FTSE_JSE_MI	-0,92 (0,78)	-12,12 (0,00)	150,28 (0,00)	1,62 (0,11)
FTSE_JSE_RI	-1,27 (0,64)	-9,29 (0,00)	214,62 (0,00)	0,89 (0,37)
M2	-0,05 (0,95)	-14,36 (0,00)	313,73 (0,00)	0,01 (0,74)
CPI	-1,03 (0,73)	-8,25 (0,00)	271,59 (0,00)	0,09 (0,73)
EXRATE	-1,84 (0,36)	-11,39 (0,00)	90,35 (0,00)	1,61 (0,11)
TBILL3M	-1,65 (0,45)	-8,58 (0,00)	104,85 (0,00)	-0,43 (0,67)
YLDLDGVTBOND	-1,05 (0,74)	-10,78 (0,00)	117,86 (0,00)	-1,35 (0,18)

Due to the nature of the series tested and the frequency of the data, a maximum of 12 lags was selected, the series also exhibited the form of a linear intercept with no deterministic trend and as such were tested on these grounds. This is normal practice as the ADF test uses a Schwarz criterion for maximum lag length. The KPSS is estimated using the Bartlett Kernel method and as such lag length is not required.

Table 3 shows the results for the VAR lag order test and, while these conflict, they present a range of lags selected by the information criteria that can be tested.

The results for the ADF and KPSS stationarity tests are shown in table 2. The results for the ADF and KPSS tests show that, at the 1%, 5% and 10% levels of significance, all the series are non-stationary at level but become stationary at first difference. The assumption that is taken from this is that the series presented are integrated of order 1, that is they are all $I(1)$, thus their linear combination will present an $I(0)$ or stationary series if a cointegrating vector or vectors are found.

5.2 Johansen Cointegration Results

The multivariate cointegration analysis was performed to determine whether any long-run relationships exist between the macroeconomic variables and each of the indices. This was achieved by specifying an independent VAR for each of the indices and the macroeconomic variables.

The Johansen cointegration approach requires an appropriate lag order and deterministic trend assumption for the VAR being specified. A correct lag length is particularly important because an inappropriate length may lead to serial correlation (Hall, 1991). Furthermore, Johansen's test statistics have been seen to be highly sensitive to the chosen lag length in past empirical studies. Thus it has been suggested by Allen and McDonald (1995) and Chinzara and Aziakpono (2009) that a range of lags should be considered from various test statistics in order to determine the correct lag length. Thus in this study, we use various information criteria to determine the minimum and maximum lag lengths. Since we are using monthly data, we used 12 as the

maximum lag order. The results on the VAR lag order selected by the information criteria are reported in Table 3.

As evident from Table 3, different information criteria selected conflicting lag orders. Since the information criteria give conflicting results, this study used the range of the lags selected by the information criteria. The cointegration test is started from the smallest selected VAR order and the lags are then sequentially increased until cointegration is found with serially uncorrelated residuals. After experimentation, the optimal VAR lag order selected for each of the indices was the fourth lag. Thus the cointegration tests were carried out using lag 4 and the results for the test are reported in Table 4. Also reported are the VAR order, the deterministic trend assumption used, and the trace and eigenvalue statistics for each cointegration equation. As can be concluded from Table 4, there is evidence to support at least one cointegrating vector for each VAR (specified by index).

Table 3: VAR Lag Order Selected by Information Criteria

Lag Criteria	ASI	FI	MI	RI
LR	11	8	9	11
FPE	4	2	2	2
AIC	4	2	2	2
SIC	1	1	1	1
HQ	1	2	1	2

Notes:

LR: Sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SIC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 4: Cointegration Results for Multivariate Models

Series	Obs.	k	A	Trace			Max		
				r<0	r<1	r<2	r<0	r<1	r<2
ASI	157	4	3	108,68 [0,00]	69,70 [0,05]	42,10 [0,15]	38,98 [0,06]	27,59 [0,23]	NA
FI	157	4	3	114,51 [0,00]	61,72 [0,19]	NA	52,79 [0,00]	31,59 [0,10]	NA
MI	157	4	3	111,03 [0,00]	74,36 [0,02]	42,70 [0,14]	36,66 [0,11]	NA	NA
RI	157	4	3	101,22 [0,01]	59,18 [0,26]	NA	42,04 [0,02]	34,23 [0,05]	11,75 [0,94]

Notes: k is VAR order lag. 'A' is the deterministic trend assumption

5.3 Weak Exogeneity Tests

Having established the existence of cointegrating vectors, it is necessary that VECM models be estimated in order to analyse the variables' reversion back to their long-run equilibrium if there happens to be short-run disequilibrium. VECM equations are estimated by normalizing the cointegration equations on the dependent variable. However, for a variable to be normalised on, it should be endogenous. It is therefore necessary that the variables which are truly endogenous be tested so that they can be normalised on. To this end, weak exogeneity tests were performed. These results for the weak exogeneity tests are reported in Table 5.

Table 5: Weak Exogeneity Tests

	INDEX	M2	EXRATE	CPI	TBILL3M	GvtBondYield
ASI	12.96(0.00)	-8.00(0.43)	-3.84(0.63)	7.08(0.69)	3.32(0.37)	5.76(0.02)
FI	8.66(0.00)	10.25(0.15)	10.29(0.09)	10.29(0.13)	10.38(0.034)	10.24(0.00)
MI	2.06(0.02)	2.50(0.12)	2.50(0.86)	2.49(0.81)	2.42(0.27)	2.58(0.47)
RI	7.25(0.05)	7.55(0.00)	7.56(0.19)	7.75(0.32)	7.62(0.60)	7.67(0.59)

Note: Reported here are the F-values and their corresponding probabilities. If the F-value is significant it means the variable concerned is endogenous and thus can be normalised on.

From the results in Table 5 it is evident that the All-Share and each of the sectoral indices are endogenous to their equation. In the principal VAR for the ASI, all macroeconomic factors are

exogenous with the exception of the YldLdGvtBond variable. This last result is not surprising as the ASI is closely linked to financial performance indices which are contained within the overall ASI performance. Thus two cointegrating vectors have been identified such that the influence of YldLdGvtBond is separated from that of the ASI on the other variables.

The Financial Index is endogenous in the second VAR, with M2 and CPI being exogenous, while EXRATE is weakly exogenous at the 5% level. TBILL3M and YldLdGvtBond are endogenous to this VAR, as expected, as their results are factors that contribute towards the overall performance of the Financial Index. This presents the case of three possible cointegrating equations being present and identified. The decision was made to identify one cointegrating vector to determine the extent to which these variables have an influence on the Financial Index regardless of the Financial Index's influence on the TBILL3M and YldLdGvtBond variables.

The Mining Index is endogenous with all the macroeconomic factors being exogenous. The effect that the rand/dollar exchange rate has over the performance of the Mining Index is largely due to the direct returns earned in foreign exchange by mining houses, and with EXRATE being an exogenous variable, there is evidence that the performance of the Mining Index may have no feedback into the EXRATE variable. This is not surprising as mining exports are unlikely to adjust in the short term to changes in the exchange rate.

The Retail Index is endogenous with all macroeconomic factors except M2 (it being exogenous). The endogeneity of M2 in this VAR could lead to it being a normalisation factor as money-supply growth leads general economic growth, thus two cointegrating equations were identified to separate this relationship.

With the results of the weak exogeneity tests indicating the normalisation variables as well as assisting in vector identification and causality, the VECM models for each index were estimated and the results are reported in Table 6.

5.4 Multicollinearity Test Using Pairwise Correlation

Table 5B: Pairwise Correlation Matrix

	FTSE_JSE_ASI	FTSE_JSE_FI	FTSE_JSE_MI	FTSE_JSE_RI	M2	CPI1975B	EXRATE	TBILL3M	YLDDGVT*
FTSE_JSE_ASI	1.00								
FTSE_JSE_FI	0.92	1.00							
FTSE_JSE_MI	0.97	0.81	1.00						
FTSE_JSE_RI	0.83	0.89	0.70	1.00					
M2	0.95	0.86	0.94	0.76	1.00				
CPI1975B	0.37	0.40	0.25	0.70	0.31	1.00			
EXRATE	0.47	0.36	0.59	0.04	0.59	-0.58	1.00		
TBILL3M	-0.63	-0.55	-0.67	-0.56	-0.68	-0.21	-0.40	1.00	
YLDDGVTBOND	-0.78	-0.70	-0.81	-0.68	-0.86	-0.35	-0.44	0.86	1.00

Table 5B present the Pairwise Correlation results for the variables contained within the identified VECM to be presented in Table 6. What is observed for the FTSE JSE series is that high levels of pairwise correlation exist between the All-Share Index and the Financial, Retail and Mining Indexes contained within the ASI. Due to market aggregation such correlation is to be expected amongst the market sectors. The high levels of pairwise correlation exhibited by the M2 variable are also to be expected as money supply represents a scale variable for the level of economic activity in the economy and would thus have a strong influence over the determination of the market Indexes described in the study. The strong levels of pairwise correlation between TBILL3M indicate that short term interest rates as discussed have an influential effect on the Indexes due to their interaction with market lending rates and investment back into the markets. The most interesting pairwise correlation that does stand out in this test for multicollinearity is that of 0.70 existing between Inflation (CPI1975B) and the Retail Index (FTSE_JSE_RI), Contributing factors to this relation are discussed in section 5.6.4. Though some of the pairwise correlation results suggest evidence of strong multicollinearity between variables, the nature of

this study, however, is to understand the magnitude and direction of the cointegrated results of the series and as such concurs with the findings of similar studies such as that of Chinzara et al (2009).

5.5 Vector Error Correction Models (VECM)

Table 6 presents the results for each of the cointegrating equations of focus. Only the cointegrating equation that normalises on the analysed stock market index in question will be presented in the case where two significant cointegrating equations were found. Thus the All-Share Index is normalised upon in cointegrating equation 1. Cointegrating equation 2 normalises upon long-term interest rates due to the evidence of endogeneity suggested in the weak exogeneity tests presented in Table 5. Consequently, a restriction upon long-term interest rates is applied in cointegrating equation 1 to allow for the full identification of both cointegrating vectors.

The VECM results for the Mining Index identify two cointegrating equations. Examining the results of the weak exogeneity test set the reasoning for normalising upon the Mining Index in cointegrating equation 1 while cointegrating equation 2 normalises upon inflation. Thus for all cointegrating vectors to be identified, inflation is restricted upon in cointegrating equation 1.

The VECM for the Retail Index identifies two cointegrating equations. As per the weak exogeneity tests in Table 5, money supply and the Retail Index both had a significant level of endogeneity. Thus cointegrating equation 1 normalises on the Retail Index, while cointegrating equation 2 normalises on money supply. Thus for a cointegrating vectors to be correctly identified, money supply is restricted upon in cointegrating equation 1 as is presented in Table 7.

The Financial Index has one cointegrating equation identified in its VECM. Thus the index itself is normalised upon. Due to this, no restrictions were needed to fully identify the system.

Table 6: VECM Results

		ASI	FI	MI	RI
	Model Selected	Linear intercept No Trend	Linear intercept No Trend	Linear intercept No Trend	Linear intercept No Trend
	Cointegrating Vectors	2	1	2	2
		<i>Cointegrating Eq1</i>	<i>Cointegrating Eq1</i>	<i>Cointegrating Eq1</i>	<i>Cointegrating Eq1</i>
INDEX	<i>coefficient</i>	1.000000	1.000000	1.000000	1.000000
	<i>T-statistic</i>				
M2	<i>coefficient</i>	4.436007	6.004130	2.146154	0.000000
	<i>T-statistic</i>	[-6.96659]	[8.50034]	[4.88099]	
EXRATE	<i>coefficient</i>	0.746763	0.754982	0.716954	-2.111620
	<i>T-statistic</i>	[3.85220]	[2.74478]	[-1.63370]	[-4.54822]
CPI	<i>coefficient</i>	-9.819778	-14.48547	0.000000	7.814661

	<i>T-statistic</i>	[-7.21473]	[-7.62912]		[-6.61306]
TBILL3M	<i>coefficient</i>	-0.096187	-0.344733	-3.438733	-2.097101
	<i>T-statistic</i>	[-0.47966]	[-1.25084]	[-4.47442]	[3.15375]
YldLdGvtBond	<i>coefficient</i>	0.000000	-0.108815	5.283487	6.310277
	<i>T-statistic</i>		[0.23715]	[4.31033]	[5.47284]
C	<i>coefficient</i>	3.082452	2.766700	25.30120	33.72041
Error Correction	<i>coefficient</i>	-0.144696	-0.1052792	-0.073608	-0.064535
	<i>T-statistic</i>	[-5.58745]	[-5.46332]	[-3.55439]	[-2.20065]
R-Squared		0.450599	0.579987	0.266445	0.521136
S.Cor		30.49 [0.7277]	37.19 [0.4138]	45.08 [0.1427]	34.86 [0.4925]

5.6 VECM Summary for the Indices

Money Supply was found to have a positive and significant effect on the ASI as well as all sectors examined, excluding the Retail sector which the variable was restricted upon. The results here are supported by studies by Gonsel (2007) and Mukherjee & Naka (1995) who also found a significant positive influence of money supply on the stock market returns.

The Exchange Rate in nominal bilateral rand/dollar terms was found to have a positive and significant influence on both the ASI, financial and mining sectors, while its effect on the retail sector was negative. It should be noted, however, that a negative sign for the exchange rate implies that an inverse relationship exists between the two variables (or vice versa if the sign is positive). The deeper implication of this to be noted is that, as the rate of exchange here is stated in rands/US dollars, we should in fact invert the sign of outcome that occurs after the VECM results are given to understand the true relationship present between the variables. As such, a positive result would show that an increase in the exchange rate variable would be a weakening of the rand against the US dollar. This would cause a resultant positive influence on the selected stock index. The works cited that support the negative relation found with the ASI and Financial sector are those of Kwon (1999), Gonsel (2007) and Adam (2008). While works by Mukherjee & Naka (1995) and Moolman (2005) support the positive market effect found in the retail sector.

Inflation was found to have a negative and significant effect on both the ASI and Financial sector, supporting work by Gonsel (2007), Mukherjee & Naka (1995) and Adam (2008).

Inflation does, however, have a positive effect on the retail sector which can be supported by the research of Nikkinen (2006). The effects and probable causes for this outcome are discussed in further detail in the Retail Index specific section.

Short-term interest rates were seen to have a negative influence against all sectors of the stock market, though only the coefficients for the mining and retail sectors were significant. Research that supports this outcome is that of Moolman (2005) and Adam (2008).

Long-term interest rates had a positive effect on both the mining and retail sectors, while the financial sector was affected negatively by movements in long rates. All coefficients were significant and the work by Mukherjee & Naka (1995) supports the findings of a negative relation with the financial sector.

The error correction term allows for the evaluation of the speed of adjustment in each sector. As the results have illustrated, the All-Share Index is by far the most efficient index as it adjusts by 14.4% within the first twelve periods, towards long-run equilibrium. The speed of adjustment in the retail sector appears to be the slowest at 6.4%. This suggests that due to the sector configuration or inter-variable relationship, long term equilibrium readjustment may be hindered.

Note should also be taken that due to the logarithmic nature of this model the coefficients represent partial elasticities for each variable. As such examining Money Supply a 1% increase in the variable would have the result of a 4.4%, 6% and 2.1% increase in the size of the ASI, FI and MI indexes respectively. The exchange rate has a far more dampened effect on the Indices examined with a 1% positive shift in the exchange rate variable resulting in .075%, 0.75%, 0.72% and a 2.1% positive increase across the ASI, FI, MI and RI respectively. Inflation has the interesting effect as noted earlier that a 1% increase in the variable causes a 9.8% decrease to the ASI as well as a -14.5% decrease to the FI while the RI actually increases by 7.8%. Short term interest rates when increased by 1% have the effect of a blanket decrease on the Indexes, such that the ASI, FI, MI and RI decrease by 0.09%, 0.34%, 3.4% and 2.1% respectively. Thus the largest effect for the movement in short term interest rates in the market is shown by the magnitude in the Mining and Retail Indexes. Long term interest rates, however, when increased by 1% in the model have the effect of reducing the FI by 0.1%, while the MI and RI increase by 5.3% and 6.3% respectively.

5.6.1 FTSE/JSE All-Share Index

The coefficient for money supply has a positive sign; this confirms our earlier *a priori* expectations that the resulting influence of increasing money supply would stimulate an aggregate demand effect in the markets thus having an overall positive stimulus on share prices. Mukherjee and Naka (1995) also found that an increase in money supply led to increased stock returns as the expansion in money supply would lead to a rise in the discount rate. The quantity theory of money attests to this finding, as an increase in money supply leads to excess liquidity in the market. Investors adjust this liquidity excess by investing in assets to reduce their liquid holdings. It is this increase in investment that stimulates an increased valuation in asset prices.

The positive sign of the exchange rate shows that a weakening of the rand against the dollar will cause an increase in gains to the All-Share Index. This conforms to our *a priori* expectations as it is a key macroeconomic factor that influences foreign investment into the local equity market. As such, a weakening exchange rate makes the relative valuation of stocks on the JSE contained within the ASI more profitable for foreign investors.

Inflation is negative in influence and is supported in both theory and practice by the findings of Fama and Schwert (1977). The findings here support the point that inflation erodes asset prices as higher returns are needed to support the increased cost of investment in the market.

Much of the period under scrutiny in this study has its course while the rate of inflation in South Africa was outside the targeted band, and before the inflation targeting was introduced in 2002. Consequently, there has been a constant level of repo rate adjustment in the market and as such inflation rates have a negative influence (as was expected in the *a priori* assumptions).

Short-term interest rates have a negative effect, but are not statistically significant in this cointegrating equation. The sign of this variable does, however, conform to theory as interest rates are expected to have a negative relationship with stock returns. This is supported by Maysami, Howe and Hamzah (2004) who reason that the inverse relationship is due to interest rates representing the cost of borrowed capital and, as such, an increased cost of borrowed capital would result in less private capital investors in the equity markets.

The error correction coefficient provides evidence that the All-Share Index would adjust towards the long-run equilibrium by 14.4% within the first year.

5.6.2 FTSE/JSE Financial Index

Money supply affects the financial sector positively; this supports the earlier argument that it has a significant effect on aggregate demand in the market, as well as being a key variable to affect the returns of the financial sector.

The exchange rate is significantly positive which conforms to earlier conclusions as to the effect of the exchange rate on asset returns in the index. The reasoning here is that the financial sector, like the All-Share Index, is open to foreign investment and as such the major financial shares contained within the index are affected by weakened exchange rates leading to an increase in foreign investment.

Inflation has a significantly negative effect in the long run, thus conforming to the earlier assumptions that inflation has an erosive effect on the returns from equities as higher rates of interest are required to counteract inflationary pressures.

Short-term interest rates have a negative effect, but do not have a significant enough t-statistic to be relevant other than its sign supporting *a priori* assumptions. Though the financial sector VAR identifies one cointegrating equation, the cointegrating results presented in the appendix also show the case with three cointegrating equations identified as this addresses the issues of the endogeneity of multiple variables in the VAR specified. This was done as there is an inherent amount of endogeneity encountered in the Financial Index with regard to financial performance measures. The insignificance of the short-term interest rate variable in the long-run parameters is therefore expected as the short-term interest rates performance are augmented into long-term run interest rates by investor expectations, when long-run parameters for short-term rates such as these being tested. Simply put, the evolution of short-term interest rate values are into long-term rates as investor expectations are coloured by the performance of short-term rates and thus get projected forward into long-term rates.

Long-run interest rates have a significantly negative effect on financial sector returns in the long run. This conforms to prior expectations as long-run interest rates will have the largest effect on the cost of borrowed capital, as well as debt repayment by customers who are long-term borrowers, which will affect the profits of companies who are financial services providers. The long-term borrowing of this nature affects large-scale expansion investments by firms in the South African market. The error correction coefficient provides evidence that the Financial Index would adjust towards the long-run equilibrium by 10.5% within the first twelve periods.

5.6.3 FTSE/JSE Mining Index

A positive effect is generated in the mining sector by increases in money supply, which supports earlier conclusions as to the relationship that money supply has with all market returns due to its aggregate demand effect.

Though exchange rates are weakly significant, they do have a positive influence on the mining sector returns. This result is opposite to the results found for the ASI and Financial Index. As such, a weaker rand position against the dollar allows mining firms to earn excess revenue gains from a weakened rand when commodity sales are repatriated to rands. This is because the significance of this relationship is important to the performance of the mining sector as listed company earnings are in USD denominated revenue. Returns are therefore proportional to the bilateral rate of rand/dollar exchange as once earnings are repatriated into rands it is this rate that influences the magnitude of domestic earnings. Consequently it was expected that the rand/dollar exchange rate would have an impact on mining company returns.

Short-term interest rates are negative in influence and thus support the *a priori* assumption and findings in the results of the other stock market indices. As 3 month Treasury Bills are often a short-term instrument for the liquidity holdings of mining firms, coupled with the performance of the Gold Price Index as an investment instrument in equity portfolios, a drop in the rate of return on treasury bills or a fall in short-term interest rates via other factors encourages investors to shift their holdings of cash into equity holdings as the return on cash or near cash investments becomes less attractive. The effect is a proposed increase on returns for shares listed in the Mining Index as shares in this sector become relatively more attractive to investors.

Long-term interest rates positively affect the mining sector returns (which is opposite to *a priori* expectations). This then suggests that the return on long-term assets has a positive co-movement with mining shares in the long run. Thus an increase in the yield on long-dated government bonds will increase the returns gained on the Mining Index. The error correction coefficient provides evidence that the Mining Index would adjust towards the long-run equilibrium by 7.3% within the first year.

5.6.4 FTSE/JSE Retail Index

Exchange rates are noted to have a negative effect on retail sector returns. This does not, however, align with previous expectations as per the All-Share Index, mining and financial sectors. Retail returns in South Africa are governed by consumer demand. A weaker rand is thus indicated to depreciate returns to the retail sector in the results. A speculative explanation for this behaviour could be that retail firms hold inventories but price their inventory holdings at a current cost of capital. The result would be a weakened rand causing imported inventories to become relatively more expensive than older stock. The cost and therefore price of this stock is raised to account for new costs. These increased costs, due to higher imported goods prices, decrease returns to the net profit of firms.

The findings that inflation has a significantly positive effect on the retail sector returns disagrees with that of the other index results, as well as the earlier *a priori* expectation that the nature of the returns in the retail sector are such that inflationary pressures affect consumer spending as opposed to investment. A possible explanation is that firms in the retail index pass on the cost of future inflationary pressures to their goods and service prices, the gains from inflationary movements generate increased returns as the effects of inflation on retail prices cause increased profit margins in this sector, such that these movements may yield better than average performance in the index.

The negative effect of short-term interest rates on the retail sector performance concurs with theoretical findings and the results of the other indices and the findings of Adam et al. (2008). Movements in short-term interest rates will affect consumer spending. Thus a drop in short-term interest rates will stimulate consumer demand through increased credit extension, and have a positive influence on returns to the Retail Index through increased profits of firms.

The significant positive relationship between long-term interest rates and the retail sector goes against *a priori* expectations of the effect of long-term government bond rates on stock prices. The contrasting results may stem from the long term interest rates and its interaction with returns to firms in the Retail Index. The error correction coefficient provides evidence that the Retail Index would adjust towards the long-run equilibrium by 6.4% within the first 12 periods.

5.7 Impulse Responses of the ALSI and the Sectoral Indices

Figure 5 shows the impulse responses of the All-Share and sectoral indices to one standard error: shocks in the various macroeconomic variables. The impulse response functions measure both the speed and sign of response of the stock market indices to shocks from the macroeconomic variables. Generally, the response of all the indices to macroeconomic variables is persistent, although the sign of response seem to vary across both the indices and the macroeconomic variable concerned. Worth noting is also the fact that, generally, the signs of response of the stock market indices to a particular macroeconomic variable tend to be consistent with the signs that were found in the VECM model.

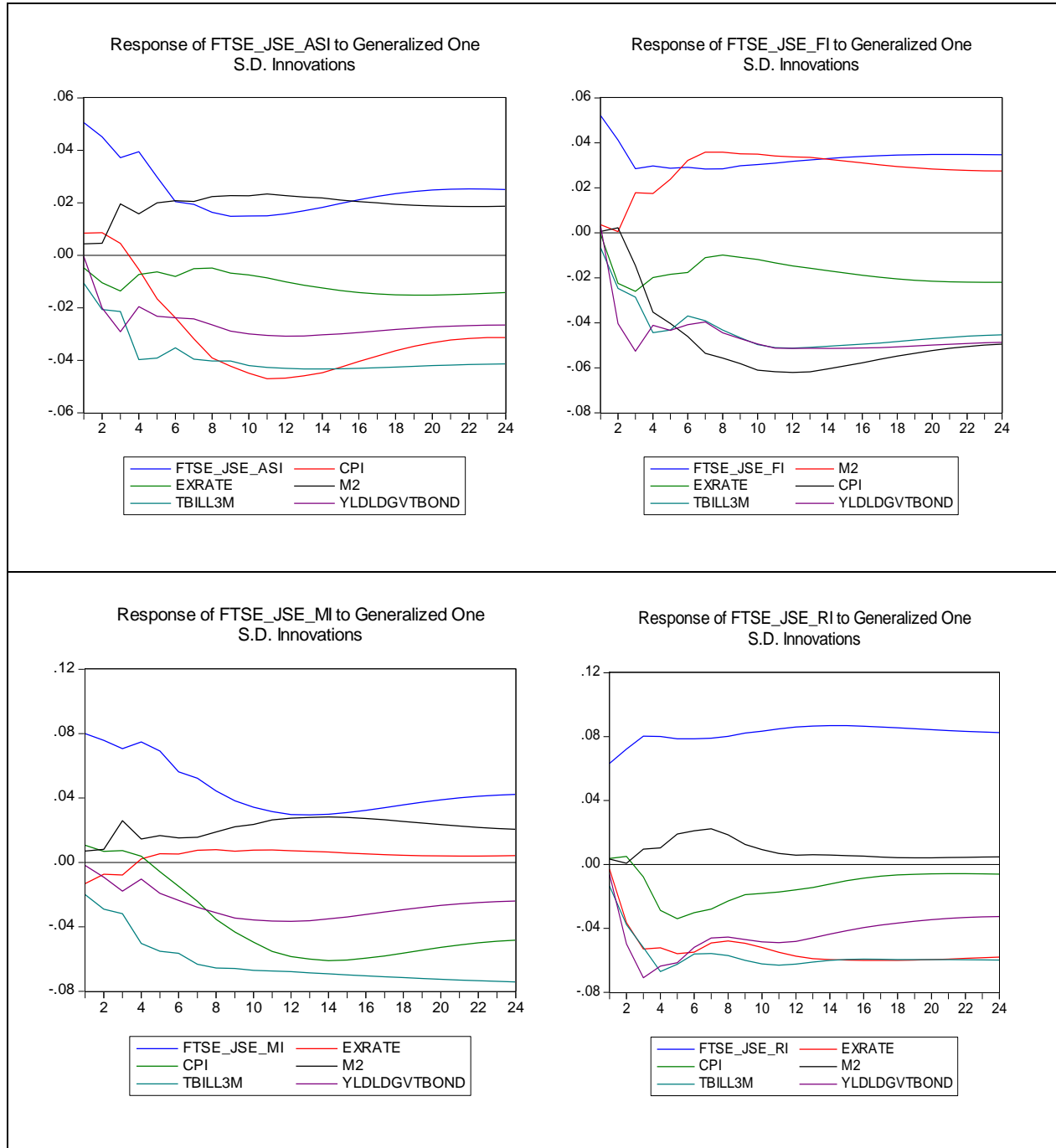
More specifically, the ALSI's responses to innovations from all the macroeconomic variables persist as far as two years (24 months). Like its response to exchange rate innovations and inflation, the responses of ALSI to long-term and short-term interest rates are negative while its response to money-supply innovations is positive.

The responses of Financial Index to all the macroeconomic variables' innovations are all persistent and last as long as 24 months. Shocks in exchange rates, inflation, and long- and short-term interest rates propagate negative responses in the Financial Index. These negative responses are consistent with the VECM results where these factors were found to negatively impact on the financial sector. Like the responses of the ALSI, the response of the Financial Index to money

supply innovations is positive. This points to the positive contribution of money supply in increasing wealth and thus the supply of funds for investments.

In line with the impulse responses of the Financial Index, the responses of the Mining Index are also quite persistent and last up to 24 months. In terms of signs of responses, the Mining Index reacts positively to shocks from money supply and negatively to shocks from short-term and long-term interest rates and inflation. Response to exchange rate innovations is mixed, with response starting negatively for first four-month period and then later becoming positive but insignificant. Generally, the signs of responses of the Mining Index to macroeconomic innovations tend to mirror the signs of the respective coefficients in the VECM model.

Figure 5: Impulse Response Functions for the Indices



Finally, like the other three indices, responses of the Retail Index to macroeconomic innovations are characterised by persistence. While the responses to innovations from money supply are positive, responses to innovations from exchange rate, short-term and long-term interest rates are negative. Inflation however here presents itself as having a negative response. This differs from the results of the VECM and may outline the short-run behaviour of the variable.

5.8 Variance Decomposition

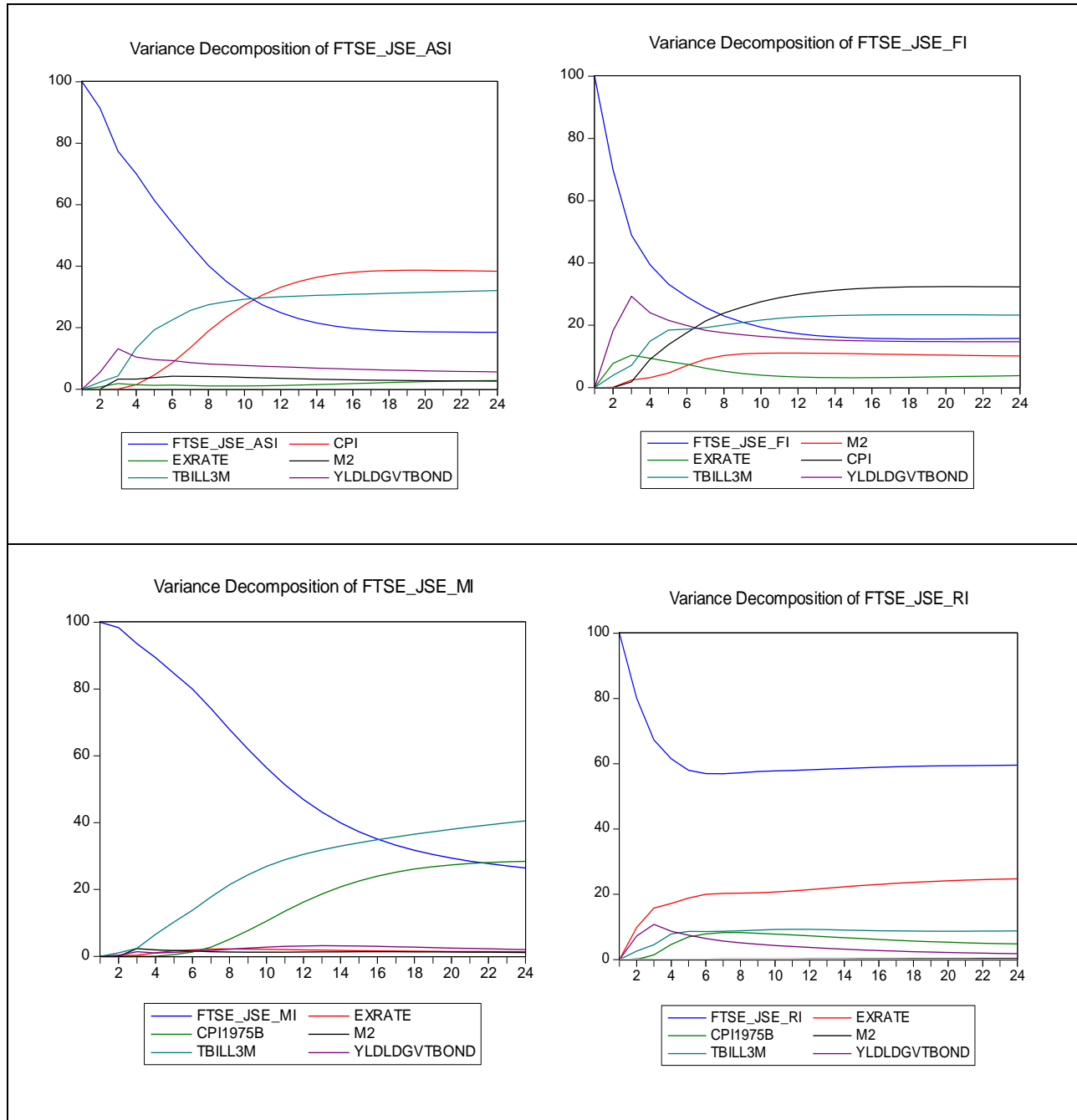
Variance decomposition functions were estimated to examine the proportion of variations in the stock market indices which is explained by each of the macroeconomic factors. The results are reported in Figure 6.

We observe that the ASI is explained 100% by itself in period 1, but after 6 months there is an ever increasing relationship between the ASI and the various macroeconomic variables. At six months the ASI only explains 54.1% of the changes in itself, with the exchange rate explaining 1.32%, short-term interest rates 22.5%, inflation 8.53%, money supply 4.22% and long-term interest rates explaining 9.30% of the changes in ASI.

After 12 months the ASI only explains 24.85% of the changes in itself, while the exchange rate explains 1.21%, short-term interest rates 30.04%, inflation 33.12%, money supply 3.51% and long-term interest rates explain 7.26%. At 12 months it can be noted that money supply and long-term interest rate yields have started to have a reduced effect on the ASI compared to their effect at six months. It is only the exchange rate variable, inflation, short-term interest rates and money supply that continue to have an increasing effect on ASI performance after a year. The effect that the macroeconomic variables had on the ASI at 12 months continues to the 24-month mark where the ASI only explains 18.49% of the changes in itself, while the exchange rate explains 2.81%, short-term interest rates 32.08%, inflation 38.36%, money supply 2.62%, and

long-term interest rates explain 5.64%. From this analysis it is thus clear that out of all the macroeconomic variables, short term interest-rates and inflation explain most of the variations in the ASI.

Figure 6: Variance Decomposition Functions for the Indices



The Financial sector is explained 100% by itself in period 1. After six months it can be seen that there is an ever increasing relationship between Financial Index and the macroeconomic variables. It is in this six-month period that exchange rates and long-term interest rates have their greatest effect on the Financial Index, with exchange rates recording a high of 10.76% in month 2 while long-term interest rates record a high of 23.99% in month 4. At six months the Financial

Index only explains 28.39% of the changes in itself, with the exchange rate explaining 7.97%, short-term interest rates 18.34%, inflation 18.40%, money supply 7.13%, and long-term interest rates explaining 19.77%. A clear long-run relationship between the financial sector returns and the selected macroeconomic variables can be seen by examining the impact from 12 months onwards.

After 12 months the Financial Index only explains 16.23% of the changes in itself, while the exchange rate explains 3.80%, short-term interest rates 22.60%, inflation 30.58%, money supply 11.32%, and long-term interest rates 15.47%. At 12 months it can be noted that the exchange rate and long-term interest rate yields have started to have a reduced effect on the Financial Index compared to their effect at six months. It is only money supply, short-term interest rates and inflation that continue to have an increasing effect on the Financial Index performance after a year. The effect that the macroeconomic variables had on the Financial Index at 12 months continues to the 24-month mark where the Financial Index only explains 14.38% of the changes in itself, while the exchange rate explains 4.22%, short-term interest rates 23.33%, inflation 32.90%, money supply 10.60%, and long-term interest rates 14.61%. Both inflation and short-term interest rates have increased their influence over the Financial Index at the 24-month mark, while all other macroeconomic factors have lost some of their predictive power.

Thus over the two years, 85.67% of variations in the Financial Index are explained by the summation of these macroeconomic factors looking at a two-year window. The largest contributors to the Financial Index are short-term interest rates, inflation and long-term interest rates, with money supply and exchange rate having comparatively little effect on the Financial Index.

In line with the other indices, 100% of variations in the Mining Index are shown by its own past lags in period 1. However, a relationship between the Mining Index and the variables start to become clear as we move to six months. For instance, at six months the Mining Index only

explains 79.98% of the changes in itself, while the exchange rate explained 1.92%, short-term interest rates 13.78%, inflation 1.29%, money supply 1.56% and long-term interest rates 1.47% of the changes in the Mining Index.

After 12 months the Mining Index only explains 46.93% of the changes in itself, while the exchange rate explains 1.94% (this is the maximum gain for exchange rates in explanatory power on the Mining Index). Short-term interest rates explain 30.51%, inflation 16.21%, money supply 1.30%, and long-term interest rates explaining 3.11% of the changes in the Mining Index. The exchange rate is a nominal bilateral rate and, as such, all gains made from favourable exchange rate movements to the mining industry may soon be eroded by increased costs incurred domestically. At 12 months it can be noted that there is a marked delay in the effect that macroeconomic variables have over the Mining Index from the two-month to twelve-month barrier. Inflation and short-term interest rates gain a larger portion of their impact in this lag. The effect that the macroeconomic variables had on the Mining Index at 12 months continues to the 24-month mark, where the Mining Index only explains 26.46% of the changes in itself, while the exchange rate explains 1.39%, short-term interest rates 40.53%, inflation 28.44%, money supply 1.14%, and long-term interest rates explain 2.04% of the changes in the Mining Index. Both inflation and the variable for short-term interest rates have increased their influence over Mining Index at the 24-month mark, while all other macroeconomic factors have lost some of their predictive power.

This evidence leads to the conclusion that variations in macroeconomic variables explain variations in stock returns within the Mining Index with 73.55% of changes being explained by the summation of these macroeconomic factors looking at a two-year window. The largest contributors to the explanatory power of the mining sector are short-term interest rates and inflation.

The retail sector is no exception to the behaviour of all the other sectors. It explains 100% of its own variations in the first period. After the first period, evidence of the influence of other macroeconomic variables starts to emerge. For instance, at month 6, the Retail Index only explains 56.99% of the changes in itself, with the exchange rate explaining 20.00%, short-term interest rates 8.59%, inflation 7.84%, money supply 0.13%, and long-term interest rates explaining 6.43% of the changes in the Retail Index.

After 12 months the Retail Index explains 58.14% of the changes in itself (which demonstrates a gradual gain in self-explanatory power from month 12 to 24), while the exchange rate explains 21.44%, short-term interest rates 9.25%, inflation 7.27%, money supply 0.19%, and long-term interest rates explaining 3.71% of the changes in the Retail Index. At 12 months it can be noted that money supply has a very minor effect on changes in the Retail Index right through until the 24-month horizon. Short-term interest rates have their greatest effect on the Retail Index at the 12-month point. The effect that the macroeconomic variables had on the Retail Index at 12 months continues to the 24-month mark, where the Retail Index only explains 59.54% of the changes in itself, while the exchange rate explains 24.75%, short-term interest rates 8.77%, inflation 4.77%, money supply 0.35%, and long-term interest rates explain 1.82% of the changes in the Retail Index. Only the exchange rate has increased its influence over the Retail Index at the 24-month mark, while all other macroeconomic factors have lost their predictive power.

Thus, 40.47% of the changes in the Retail Index are explained by the summation of these macroeconomic factors looking at a two-year window. The largest contributors to this explanatory power are the exchange rate and interest rate, while the other factors play quite a negligible role.

This chapter presented the results of the econometric tests used in the study. Evidence was found to support the relationships that exist between macroeconomic variables and sectors of the South African stock market. A clear influence of direction of causality from macroeconomic variables

to stock market indices was found. The response to shocks from macroeconomic variables in each sector of the stock market examined was found to be subject to a lag. The final outcome concluded in this chapter was that macroeconomic variables do have an effect on stock market prices in the long run, and that their short-run influences have a lagged effect on the market. The next chapter presents the findings of the paper and concludes the study with remarks and further recommendations for future expansion.

Chapter 6: Conclusion

The chapter presents the findings of the study and econometric results in summary with commentary into the proposed effect of the macroeconomic variables on stock market prices. Recommendations and limitations of the study are also noted.

The study made use of the Johansen cointegration method to analyse the relationships found between a number of macroeconomic variables and sectoral indices of the South African stock market. The conclusion of this study is that long-run relationships between macroeconomic factors and share prices on the JSE exist. This finding concurs with international studies which found that markets, whether they are developing or developed, are all influenced by various macroeconomic factors. The key macroeconomic factors examined in this study are inflation, exchange rates, long- and short-term interest rates and money supply. These factors are shown to have a shaping effect exogenous to the stock market itself on prices within the market. The implications of this are that changes in the selected macroeconomic factors can be used to predict future moves in stock prices. The predictive influence is discussed further below with specific reference to each sector and the outcomes.

The All-Share Index represents an aggregate covering of major stocks and economic groupings within the JSE. This study shows that the ASI is influenced by selected macroeconomic variables. All the selected macroeconomic factors have an influential effect on the ASI, the largest of these contributors, with a negative effect, being inflation and the rand/dollar exchange rate, while money supply had a positive effect. A large portion of JSE investors are foreign and are influenced by changes in the exchange rate on share-price valuation. They thus benefit from a weaker rand position when investing in the South African stock market. The rest are domestic investors who are affected by the factors of inflation and market growth. Thus, in the long run, an unfavourable outlook in either of these factors will cause a marked swing in price

performance on the ASI, with an increase in money supply or a decrease in inflation having a positive effect on the stock market. The speed of adjustment in this market was also good as suggested by the short-term error correction coefficient with a speed of 14.4% readjustment towards long-term equilibrium in the first twelve months. Focusing on the ASI (which comprises a representation of the whole market in this study), this is indicative of an efficient South African investment market on the whole.

The financial sector represents the assets and holdings of the major banks, insurance and life assurance institutions. The sector is affected positively by the rand/dollar exchange rate and money supply as a constant growth in M2 is indicative of a stable and healthy economy (the benefits of which are economic growth). A strengthening rand affects the Financial Index like it does the All-Share Index, with boosted foreign investment gains in the market causing increased returns. Inflation has a very strong negative effect on the financial sector returns. Inflation affects both the rate of return for foreign investors and also reduces the returns on investment for domestic investors. Long-term interest rates have a negative effect on this sector, but the magnitude of the coefficient was far smaller than that of inflation.

The mining sector is representative of the major mining and mineral concerns in South Africa. The returns to this sector are most strongly affected by movements in money supply as well as short- and long-term interest rates. Money supply and long-term interest rates both impact positively, while short-term rates have a negative effect. The mining returns are affected positively by the rand/dollar rate due to commodity prices being dollar denominated and, as such, the rand revenue earned on the sale of said commodities would be impacted by changes in the exchange rate. Thus a stronger rand, relative to the dollar, would reduce gains earned by the sale of mining commodities and vice versa. Both the Impulse Response and Variance Decomposition tests support the significance of an exchange rate effect, albeit a small one. The contributing factor to this could be an insulating factor present in the Mining Index between exchange rate movements and direct index gains. Both short- and long-term interest rates play a strong part in the influence of returns to the mining sector, though the impact of short-term

interest rates is negative and that of long-term rates is positive. The former could indicate high levels of debt amongst mining firms but it is unclear why long-term rates have a positive effect.

The retail sector comprises all major consumer goods companies. Thus this sector is strongly influenced by inflation and exchange rate concerns. Though this influence is positive for inflation, it is attributed to inflationary concerns impacting on consumer end-pricing to the extent that cyclical goods experience an upswing in consumption and wealth-effect shifts during this period. The rationale for a weaker rand against the dollar having a negative effect on the index is that retail importers of goods or producers who use factors of production that are exchange rate dependant will incur increased costs as the rand weakens against the US dollar. Long-term interest rates had a strong influence on the retail sector with a large positive coefficient while short-term interest rates had a negative effect but with a far smaller coefficient.

From the results of the impulse response and variance decomposition analysis it has been shown that the indices examined on the JSE are sensitive in the short run to movements in macroeconomic factors. Furthermore, this sensitivity has a lag but becomes most dominant after six months. The degree of sensitivity in the short run, along with the fast speed of adjustment by the indices back to their equilibrium position before the shock, highlights that macroeconomic variables are strong indicators for movements in the short-term pricing behaviour of shares on the JSE.

Though most studies used as evidence utilise a domestic bilateral exchange rate with the US dollar to measure exchange rate influences as does this paper, this could hide some of the more significant effects of exchange rate movements on the share market in South Africa. Thus further recommendations to expand upon this study would be to include a measure of a real effective exchange rate, as this may help substantiate the expected stronger linkage between exchange rate movements and changes in the Mining Index as well as to provide a deeper look into the exchange rate implications for the retail sector. Further analysis could examine the degree to

which different monetary aggregates (i.e. M1, M2, and M3) may have different impacts on the share market indices and which measure may be the most applicable in the South African case. Inflation was seen to have a positive influence on the returns for the Retail Index. A more in-depth look at this effect could be taken in future studies to ascertain whether this effect is the consequence of an excessive passing on of costs from retailers to consumers.

The findings for the ASI were in agreement with the works of Van Rensburg (1998) and Coetzee (2002) as both found inflation and exchange rate to have the same effects as the findings of this study. As this is the first study examining the sectoral impact of macroeconomic factors within South Africa no comparison can be made to previous results though the Mining Index was found to behave in a similar manner to the Gold index examined by Van Rensburg (1998) with respect to an exchange rate influence.

The paper has demonstrated that the selected macroeconomic variables do have an effect on share prices in the analysed indices of the JSE. Not all effects proved to be as strong as would be theoretically expected (such as the under performance of the exchange rate variable on the Mining Index and the weak impact of short term interest rates on the All-Share and Financial Indices). The overall result of this study has been to highlight the significantly differing results that macroeconomic variables have on selected areas of the stock market. These differences are both in order of magnitude and in direction. Few studies have previously attempted to analyse the differing sectors of the stock market and rather studied general All-Share price movements. The study set about to examine whether broad-based assumptions on macroeconomic variables may have differing effects at a lower level in the economy or be industry-specific in their significance. The objectives of the study have been achieved and have highlighted strong factors of influence for each index examined.

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8. APPENDICES:

APPENDIX 1: SUMMARY OF LITERATURE REVIEW

Study/ Author	Country/Region	Variables	Results
Adam 2008	Ghana	Exchange Rate (Real)	-ve
		Inward FDI	+ve
		Inflation (CPI)	-ve
		Interest Rate (91d Tbill)	-ve
		World Oil Prices (avg)	-ve
Ansotegui et al. 2002			
Coetzee 2002	South Africa	Inflation	-ve
		Exchange Rate	-ve
		Interest Rates (91d TBill)	-ve
Frimpong 2009	Ghana	Inflation	+ve
		Money Supply	+ve
		Interest Rates	+ve
		Exchange rates	-ve
Gan et al. 2006	New Zealand	Inflation	
		Exchange Rate	
		GDP	
		Money Supply	
		Interest Rates	
Gunasekarage 2004	Sri Lanka	Money Supply (M2)	+ve
		Interest Rates (91d TBill)	-ve
		Inflation (CPI)	-ve

		Exchange Rate	-ve
Gunsel 2007	England	Term Structure of Interest Rates	+ve
		Unanticipated Inflation	-ve (significant in Food)
		Unanticipated Industrial Production	-ve / +ve at 1month lag
		Risk Premium	
		Real Exchange Rate	+ve
		Money Supply	-ve
		Unanticipated Dividend Yield	+ve
			-ve
Hondroyiannis et al. 2001			
Horobet 2008	Central and Eastern Europe	GDP	+ve
		Inflation	-ve
		Money Supply	+ve
		Interest Rates	+ve
		Exchange Rate	-ve
Islam 2003	Thailand	Interest Rate	-ve
		Inflation	-ve
		Exchange Rate (Real)	-ve
		Industrial Productivity	+ve
Jefferis 2000	South Africa		
Karamustafa 2002	Turkey	Industrial production	+ve
		Exchange Rate	+ve
		Money Supply (M2)	+ve

		Trade Balance	-ve
Kwon 1999	South Korea	Exchange rate	-ve
		Trade Balance	+ve
		Money Supply (M1)	-ve
		Production Index	+ve
Lee 1992			
Leigh 1997	Singapore	Money Supply (M2)	
		GDP	
		Consumption	
		Real Exchange Rate	
		Interest Rates	
		Wealth	
Maysami 2004	Singapore	Interest Rate (91d TBill)	Sectoral study see review for outcomes
		Inflation (CPI)	
		Exchange Rate	
		Industrial Production	
		Money Supply (M2)	
Maysami 2001a	Malaysia/Thailand	Interest Rate	Sectoral study see review for outcomes
		Inflation	
		Money Supply (M2)	
		Exchange Rate (Real)	
		Industrial Productivity	
Maysami 2001b	Japan/South Korea	Interest Rate	Sectoral study see review for outcomes
		Inflation	

		Money Supply (M2)	
		Exchange Rate (Real)	
		Industrial Productivity	
Maysami 2002	Hong Kong/ Singapore	Interest Rate	Sectoral study see review for outcomes
		Inflation	
		Money Supply (M2)	
		Exchange Rate (Real)	
		Industrial Productivity	
Moolman 2005	South Africa	GDP	+ve
		Discount Rate	-ve
		Gold Price	+ve
		S&P 500	+ve
		Rand/US Dollar Exchange Rate	+ve
		Short-Term Interest Rate	-ve
		Risk premium	-ve ,+ve at lag 1
Mukherjee 1995	Japan	Exchange Rate	+ve
		Inflation (CPI)	-ve
		Money Supply	+ve
		Real Economic Activity	+ve
		Interest Rates (Long term government bond rate)	-ve
		Interest Rates short term (Call money rate)	+ve
Nikkinen 2006	Global	Consumer Confidence	-ve
		Inflation (CPI)	+ve

		Employment Cost Index	+ve
		Employment Situation	+ve
		GDP	+ve
		Import & Export Price Indices	-ve
		NAPM: Manufacturing	+ve
		NAPM: Non-Manufacturing	+ve
		Producer Price Index (PPI)	+ve
		Retail Sales	-ve
Nishat 2005	Pakistan	Industrial Production	+ve
		Inflation	-ve
		Money Supply	+ve
		Short-Term Interest Rate	-ve
Olalere 2006	South Africa	Interest Rates	-ve
		Inflation (CPI)	-ve
		Exchange Rate	-ve
		GDP	+ve
Paavola 2006			
Rahman et al. 2009	Malaysia	Money Supply	
		Interest Rates	
		Exchange Rate	
		Domestic Reserves	
		Industrial Production	
Samitas 2008	Europe	Domestic Interest Rate	

		US Interest Rate	
		Domestic Production	
		US Production	
Simpson et al. 2002	Australia	Interest Rates	
		Exchange Rate	
Van Rensburg 1998		Gold Price	
		Exchange Rate	
Vuyyuri 2005	India	Interest Rates	-ve
		Inflation (CPI)	-ve
		Exchange Rate (Real)	-ve
		Stock Return	+ve
		Industrial Productivity	+ve

APPENDIX 2: MACROECONOMIC VARIABLES VS JSE SECTORAL INDICES

