FACULTY OF COMMERCE

The impact of macroeconomic variables on the Johannesburg Stock Exchange (JSE) indices

BY

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Abstract

This study aims to examine the long-term relationship between macroeconomic factors and stock market index levels for selected indices through a structural model which consists of a security valuation approach in the form of Dividend Discount Model(DDM) and an Engle and Granger cointegration model. The macroeconomic variables examined include inflation, money supply, exchange rates, index earnings, and interest rates. The data was gathered from various sources such as Bloomberg, and I-Net and was analysed over a period of 20 years from 2001 to 2021 on a monthly basis. Engle and Granger cointegration and the Error Correction Model (ECM) have been used to examine the long-term relationship and the deviation from long-run market equilibrium. In addition, this study also applies the impulse response function and variance decomposition to evaluate the stock market's response to macroeconomic shocks and to determine the magnitude of influence of each variable on the share price level. The results reveal that macroeconomic variables and stock market index levels are cointegrated and index levels deviate from long-term market equilibrium. Future research may consider evaluating qualitative variables and share price long-term relationship, this might answer the question of investor sentiments impact on mean reversion.

Key words: Engle and Granger Cointegration, Error Correction Model, Index levels, Macroeconomic Variables

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Chapter 1

1.1 Introduction

Stock indices are believed to be a barometer of an economy as they provide a standardized measure to monitor the performance of different sectors of an economy. They are segments of financial markets that represent a theoretical basket of assets. For example, to gauge how the South African market is performing, the returns of the All-Share Index (ALSI), which constituents 99% of the total market capitalization of the Johannesburg Stock Exchange (JSE) listed stocks can be assessed. Stock indices in this paper will be used to mimic asset/security prices.

A significant amount of literature has been done to assess the factors influencing asset prices in both developed and emerging markets. Various asset pricing models have been used such as the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT). Both models lie on the premise of the Efficient Market Hypothesis (EMH) proposed by Fama (1965/70). The EMH theory states that security prices fully reflect all available information at any given time Fama (1970) and therefore implies that investors cannot earn an above return by conducting technical or fundamental analysis unless one has access to private/insider information.

However, various researchers have provided counterarguments to the conclusions drawn by the EMH theory. They conclude that stock returns are influenced by macroeconomic variables such as inflation and production. Most of these studies include Fama and Schwert (1977) and Jaffe and Mandelker (1976) Fama (1981,1990), MacDonald (1997), Ferson and Harvey (1991), Chen et al, (1986), and Schwert (1990) conclude that there is a correlation between macro variables and stock returns, although to differing extents. One of the main arguments provided is that the intrinsic value of an asset/security/equity share calculated using the Discount Dividend Model (DDM) is influenced by economic fundamentals. This is because an asset price depends on the present value of dividends which are paid from company earnings and these earnings are in turn influenced by macroeconomic activities; consequently, affecting an asset price. Shiller (1981) and Leroy and Porter (1981) hold similar views as their results show that macroeconomic factors affect the discount rate and the generation of cashflows, these are two fundamental variables in determining the intrinsic value of an asset when using the Discounted Cashflow (DCF) method.

Additionally, Chen, Roll, and Ross (1986) using the APT model found that discount rates are influenced by economic factors which in turn impact a firm’s cash flow and future dividend payouts. These results lay on the assumption that a long-term equilibrium exists between macroeconomic variables and prices (Maysami, Howe, and Hamzah,2004).

Furthermore, both the CAPM and APT models have been critiqued by various scholars although APT is the preferred one among the two models. With regards to the CAPM, researchers have suggested that it is incorrect mainly because of the assumptions of the model. Roll (1977) states that the assumptions of the CAPM are unreasonable as they seem to be unrealistic and not applicable to the real world especially the identification of the mean efficient portfolio.

The APT model is preferred over CAPM because several studies such as (Banz) 1981 and Basu (1983) found additional factors that impact returns and in turn explain the anomalies that the CAPM model presents. However, the main drawback of the APT is that it does not specify the underlying factors, nor does it state the appropriate number of factors to be used in the model.

An alternative to both these models is the use of various statistical techniques. One of the statistical techniques used to examine the relationship between economic variables and the stock market or asset prices is by using cointegration analysis. This method was proposed by Granger (1986) and Johansen and Juselius(1990) to establish if long term equilibrium exists among selected variables. This has become a preferred approach to examine the relationship between economic variables and the stock market. One of the reasons to this is the fact that cointegration allows nonstationary variables to be constructed in a way that results are statistically and economically meaningful (Jankowitz,2011).

The purpose of this paper is to investigate the long-term relationship between macroeconomic variables and the level of the stock indices on the JSE using a post- apartheid data. This is done by using the Engle and Granger cointegration. This technique allows us to explore the dynamic co-movement among the variables and as such, an error correction model will also be employed.

Harasty and Roulet (2000) state that there are two approaches to asset price prediction and asset price drivers' assessment. The most common approach that some authors like Fama (19981), Ferson and Harvey (1991), and MacDonald (1997) used to establish long term relationship between macro fundamentals and index levels is Cointegration and Error Correction Models. This approach makes use of an econometric model to establish the index level drivers, this method, however, lacks theoretical grounding although it will make more sense to forecast index level using its drivers. Another approach used by Moolman (2005) makes use of asset intrinsic value to compute the fair value at a point in time, the intrinsic value may be calculated by DDM, a share valuation model put forward by Gordon and Shapiro (1956). The weakness of DDM is that it makes use of theoretical assumptions that lack certainty in real markets and also cannot give an exact market prediction.

This study made use of both DDM and Cointegration to ascertain the relationship between index levels and macroeconomic factors in a bid to overcome their weaknesses of making use of theoretical assumptions which lack certainty in real markets and the lack of theoretical grounding respectively. The paper estimated the long-run relationship between macroeconomic factors and index levels through Engle and Granger cointegration model with present value theory being the baseline theory. Furthermore, short-term deviations from the market equilibrium were explained by ECM, IRF and Variance Decomposition.

1.2 Relevance of the study

In South Africa, notable research has been done on the subject, with empirical investigations on the co-movement between economic variables and J.S.E by Van Rensburg (1995,1998,1999). Jefferis and Okeahalam (2000) also made a huge contribution to the study by employing cointegration analysis and error correction models. However, most of these studie's sample period was the Apartheid era, a time during which the economy was hit hard by sanctions, capital outflows, and heavy trading restrictions.

This paper will focus on establishing a long run equilibrium between macroeconomic variables and index levels using post- apartheid data. It is beneficial as there has been enormous post-apartheid economic shifts in South Africa, such as significant capital inflows and foreign direct investments, Masipa and Masipa (2018) states in 1997 there was a marked increase in FDI from`R3.5 billion to R176.6 billion, and between 2004 and 2005 alone, FDI increased by 671%, most of this FDI was through mergers and acquisitions. These economic shifts have contributed to the expansion and effectiveness of the Johannesburg Stock Exchange (JSE), as well as improved the sensitivity to macroeconomic conditions.

Therefore, this research is a better representative of current market conditions and add to existing literature. Additionally, it aims to support found existing statistically significant variables by scholars such as Van Rensburg (1995,1998, 1999). The study further proposed a structural model which used DDM and Cointegration econometric models to establish the short term and long term dynamics between asset prices and macro fundamentals, the model can potentially forecast asset price movements in the medium term as revealed by IRF and Variance decomposition at the back of ECM.

1.3 Impact/ Use of results

Before making any investment selections, investors carefully evaluate the stock market's performance. They do so by looking at the performance of the composite index, macroeconomic indicators, and international stock market performance, particularly JSE equities. This is because highly developed markets are of great importance to investors, and the earnings or returns of major sectors on the JSE have a significant impact on the JSE's performance. As a result, each active investor should be interested in the study because it will help them make better-investing decisions.

Therefore, this study will be useful to investors in identifying some basic economic elements to focus on while investing in the stock market, allowing them to make their own asset allocation decisions.

1.4 Structure of the study

The remainder of this paper is organized as follows

Chapter 2: This section takes a deep dive into previous literature on the topic starting with the Global and South African perspective followed by a theoretical framework that discusses major theories supporting this study. The theoretical framework is followed by Institutional considerations which speak to government intervention on macroeconomic variables, which are discussed under the conceptual framework.

Chapter 3: This section discusses the methodology of the study and data sources. It further discusses Engle and Granger cointegration model coupled with ECM, Impulse Response Function (IRF), and Variance Decomposition.

Chapter 4: In this chapter, we discuss the results obtained from the models discussed in chapter 3 and present all the results in tables and graphs.

Chapter 5: In this section, a conclusion is given then limitations of the study are discussed and finally recommendations are made.

Chapter 2

2.1 Literature review

At the very least sophisticated level of economic theory lies the belief that certain pairs of economic variables should not diverge from each other by too great an extent, at least in the long run. Thus, such variables may drift apart in the short run or according to seasonal factors, but if they continue to be too far apart in the long run, the macroeconomic fundamentals such as market mechanisms or government intervention, will begin to bring them together again (Granger, 1986).

This study seeks to establish co-movement between the stock market index and chosen macroeconomic variables (**Table 1**), based on the idea that the forces driving the economy have a substantial impact on the markets, particularly free float markets such as equities markets (Johnson, et al.,2012). Chen, Roll, and Ross (1986) also found that macroeconomic variables have an impact on equity returns.

Gordon's (1959) dividend discount model posits that the share price is the total of discounted expected future dividends. Miller and Modigliani (1961), however, argued that the driver of a company's share price is the earnings of the business since the dividends are paid from the earnings. As a result, that affects share price influences expected cashflows and the discount rate used to discount the value of the future cashflows. Many previous studies selected macro variables based on this assertion, for example, Paul Van Rensburg's (1998) multifactor Arbitrage Pricing Theory (APT) in JSE. It is on this basis that the researcher is further considering how selected index earnings influence the share price.

The study considered global literature on macro-economic variables and then narrowed it down to the South African perspective.

2.2 Global perspective

Mukherjee and Naka (1995) looked into the Japanese Stock Market and discovered a long-run positive association between the YEN/USD, money supply, production index, inflation, and exchange rate, as well as a negative relationship between long-term government bond rates and the JSM. Dhakal, Knadil, and Sharna (1993) used Vector Autoregression (VAR) to investigate the relationship between the supply of money and US asset prices based on money market equilibrium requirements. The results disclosed that changes in the money supply have a significant impact on stock price movements in the US. According to Abdullah and Hayworth (1993), money supply growth and inflation are positively associated with U.S stock performance, whereas the current account balance and short- and long-term interest rates are negatively associated.

Cheung and Ng (1998) looked at the U.S, Canada, Germany, Italy, and Japan and concluded that there was long-run indication of country-specific macroeconomic factors. Money supply, oil prices, GDP, and real consumption portrayed a significant association with the stock markets. Oil prices showed a negative relationship with share price and GDP had a positive relationship with share price and the impact money supply on the stock markets were not clear.

Clare and Thomas (1994) looked into the effect of 18 economic fundamentals on the stock market in the United Kingdom. They found that oil prices, the retail price index, interest rates, and corporate default risk all had a substantial effect on stock returns. Gunsel and Cukur (2007) investigated the impact of interest rates, risk premiums, exchange rates, supply of money, and inflation on stock market performance in the United Kingdom. The results revealed that macroeconomic variables played a vital role in stock price changes and the regression results revealed differing effects from one sector to another.

Choi and Yoon (2015) performed a cointegration analysis and vector error correction model together with causality test for South Korean economic activities and the study found that the Korean stock market reflected the macro variables on the stock prices. A long-term relationship existed as the variables were cointegrated with money supply, production index, exchange rate, and trade balance suggesting a long-run relationship with each stock index.

Nasseh and Strauss (2000) investigated for the existence of a long-run relationship between the stock market and domestic and international economic activity in France, the Netherlands, Switzerland, Italy, Germany, and the United Kingdom. They found a long-run relationship with large positive coefficients for industrial production and inflation, they however, observed a significant negative coefficient for short-term interest rates. The study found that considerable explanatory power exists in forecasting stock price changes.

Karamustafa and Kucukkale (2003) validated this finding when they looked at the long-term association between stock returns and macroeconomic activity in Turkey, using the Istanbul Stock Exchange as a proxy for stock market performance. Their research looked at the production index, money supply, exchange rates, and trade balance, and discovered a cointegration between selected macro factors and stock returns, indicating a direct long-run equilibrium. Macro variables, on the other hand, were not shown to be leading indicators for stock market performance.

2.3 South African perspective

A fair share of research has been done in South Africa to test the relationship between macro variables and stock market index levels with various. Few studies however have been done on how to index earnings impact stock market performance.

Barr (1995) used a factor analytic approach to establish a relationship between chosen macro factors and the JSE. He looked at the gold price, short-term interest rates, international stock market, and domestic business confidence. He concluded that the selected macro variables and JSE results had a substantial association. Van Rensburg (1999) looked into the relationship between the JSE, industrial, and gold indices, concluding that gold and foreign reserves, long-term interest rates, and the current account balance all had an impact on the returns of stock market indices.

Van Rensburg (1998) conducted a bivariate Granger causality test to ascertain the causal relations between JSE and macro variables and concluded that stock returns are forward-looking. Jeffers and Okeahalam (2000) performed a cointegration test together with an error correction model to model Botswana, Zimbabwe, and South Africa and their results show that real stock prices are positively related to exchange rate and GDP and negatively related to long-term interest rates in South Africa.

Economic influence on South African stock returns was modelled by Gupta and Modise (2011). In the near run, their findings show that in-sample projections, money supply, interest rates, and global oil production increases all have some predictive value. Out of sample projections, interest rates, and money supply all point to short-term predictability, whereas the consumer price index has great predictive capacity.

Alam and Uddin (2009) investigated the empirical link between stock index and interest rates for fifteen countries, including South Africa, using time series and panel regressions, and found a negative relationship between interest rates and stock index. They did not, however, consider the causality. Mngani (2008) used an augmented GARCH model to investigate the impact of the discount rate and gold price on the JSE, with the result being a change in mean returns. As a result of the contractionary monetary policy, share returns have fallen, while gold prices have risen, causing the JSE/ALSI to rise.

With JSE, Moolman and du Toit (2005) looked at the short- run and long-run links between local and foreign factors. Using cointegration and error correction methods, they established a basic model of the JSE. They concluded that asset prices are cointegrated with factors stipulated by the asset price determination model's anticipated present value model.

2.4 Theoretical Framework

2.4.1 Dividend Discount Model

Stock market index level can be influenced by several macroeconomic variables, the Dividend Discount Model by Gordon and Sharpiro (1956) better explains how earnings and interest rate influence the value of a stock. In its simplest form, the index level is influenced by the stock price volatility or volatility of the index constituents. The value of equity can be estimated by the Dividend Discount Model (DDM) which uses future expected dividends together with a discount rate as the basis of valuation.

The main premise is that the highest price that investors are willing to pay for a company equals the present value of future projected dividends, following the conclusions of the Efficient Market Hypothesis (EMH). According to Campbell and Shiller (1988), the stock market's volatility is influenced by future dividends and expectations related to them, because the pay-out ratio of business dividends is reliant on the status of the economy. Take a look at equation 1 for the DDM.

$$\text{Value per share of stock} = \sum_{t=1} \frac{E(DPS)}{(1+Ke)^{\wedge}t} \qquad (1)$$

Where:

$E(DPS_t)$ = Expected dividends per share

K_e = Cost of equity

According to Adeniji (2015), stock prices are the discounted present value of the expected future cashflows, and the fundamental value of common stock is equal to the present value of expected dividends which essentially reflects the economic activities. The security prices are therefore a function of future cashflows and the discount rate. According to equation 1, the numerator, that is dividends is entirely funded by the corporate earnings, an argument put forward by Modigliani – Miller (1961).

According to Modigliani-Miller's argument, it stands to reason that expected corporate earnings are positively related to the equity prices. The denominator which is the discount rate is directly influenced by interest rates, discount rates, in turn, influences future cashflows. An increase in interest rates increases the required rate of return which negatively affects the value of the asset. Intuitively, interest rates are likely to be negatively related to the equity prices holding other things constant. Generally, if the interest rate increase, the opportunity cost of holding equities will increase from an asset allocation standpoint and investors then invest in alternative assets like bonds.

If dividends grow at a constant rate (g), the required rate of return on the index (k) equals risk-free rate(rf) plus a risk premium (rp), and that both rf and rp are constant overtime then equation one can be formulated as follows:

$$P_t = \frac{D(1+g)}{(rf+rp-g)} \quad (2)$$

Any slight change in Dividends, g, rf, and rp results in a huge variation in the equilibrium price (P_t), this brings in the concept of EMH discussed below.

2.4.2 Efficient Market Hypothesis

The efficient market hypothesis, often known as the random walk theory, assumes that market prices should take into account all available information at any given time. Eugene Fama (1970) coined the phrase "efficient market," stating that "on average, competition will cause the full effects of new information on intrinsic values to be reflected instantaneously in actual prices in an efficient market." An efficient market, according to Fama, is "one in which prices always represent all available information." Profiting from projected price fluctuations is unlikely and difficult, as the efficient market theory argues that the arrival of fresh information is the primary cause of price changes.

Various types of information, on the other hand, have different effects on security values. As a result, depending on how "available information" is defined, the efficient market hypothesis is expressed in three ways: weak form hypothesis, semi-strong form hypothesis, and strong form hypothesis.

The semi-strong hypothesis is the subject of this work because it is the most practical for our research. In fact, according to the semi-strong hypothesis, all publicly available information has already been absorbed into current prices; that is, asset prices reflect all publicly available information. Indeed, because it assumes that economic factors are fully represented in stock prices, the semi-strong hypothesis is used to study whether there is a positive or negative link between stock return and macroeconomic variables.

Data stated in a company's financial statement, as well as the financial position of the company's competitors, are examples of public information. As a result, information is public, and there is no way to profit from information that everyone else has access to.

2.5 Institutional Framework

The South African Reserve Bank (SARB) plays a significant role in the fluctuations of the economy as a whole. In a bid to fulfil its constitutional mandate of keeping stable macroeconomic variables, SARB manipulates short-term rates (repo) to control the level of inflation in the economy. As posited by Smit et al (1996), when the economy is moving into a down swing, the SARB will decrease short-term rates to stimulate spending and production. The opposite is done when the economy is overheating or if the level of targeted inflation has been exceeded.

According to Jonsson (2001), SARB used money supply to directly impact liquidity conditions in the 1970s before switching to a more mixed system in the early 1980s, in which money supply was managed indirectly through short-term interest rate adjustments. According to Jonsson (2001), due to political upheaval, the SARB established a more direct monetary targeting strategy between 1980 and 1994, in which the increase of the broad money supply was the major objective to reduce inflation rates. In February 2000, the SARB switched to an inflation-targeting monetary policy framework. As a result of the uneven manipulation and modifications of macroeconomic variables at various stages, these variables are non-causal or have a negligible impact on stock market index swings as revealed by Jonsson (2001).

According to Alatiqi and Fazel (2008), macroeconomic variables function as a transmission mechanism from one component to another, eventually counteracting each other and their effect on the stock market. A rise in the money supply produces excess liquidity in the market, which leads to an increase in price levels and, as a result, inflation. To preserve money market equilibrium, this increase in money supply induces a fall in interest rates. In the long run, this equilibrium effect should be roughly neutral. As a result, due to the involvement of other variables, a single variable will not have a major impact on stock market results. The ability of SARB to influence the macroeconomic variables is instrumental to the economic analysis and how macro variables influence stock market index.

2.6 Conceptual Framework

The influence of macro factors on stock returns has been documented in the literature. Chen, Roll, and Ross (1989) looked at inflation, interest rates, exchange rates, productivity, unemployment, money supply, government bond rates, and oil prices. Fama and Schwert (1977) investigated the relationship between equity market returns and capital expenditure, industrial production, GDP, money supply, lag inflation, and interest rates in the United States, finding a significant direct relationship between equity market returns and capital expenditure, industrial production, GDP, money supply, lag inflation, and interest rates. Geske and Roll (1983) found a strong link between stock returns and macroeconomic variables; Black, Fraser, and MacDonald (1997) found a similar link.

It is worth noting that some macro variables are highly correlated and influence changes or movements on each other, for example, inflation, interest rates, and money supply are highly correlated through monetary policy and liquidity effects. This makes it difficult to diffuse the specific impact on these variables independently (Macdonald & Ricci, 2004). The period under consideration for this study has witnessed multiple monetary policies by the SARB so that they achieve and sustain various objectives. Furthermore, policy inconsistency, as well as monetary, fiscal and exchange rate policies, have shown conflict movements at times (De Kock Commission, 1984). One notable policy that has been inconsistent for the longest time is fiscal policy (Aron & Muellbauer, 2000).

Ehramnn and Fratzher (2004) in their research observed the limitations of using VAR models and longer frequencies for analyzing monetary effects. They quote research by Rigobon and Rigobon & Sack, (2004) states that monetary policy reacts to stock market movements by considering the influence of aggregate demand. They further explain that ignoring these endogeneity factors may introduce a significant bias in empirical estimations of the stock return's reaction to monetary policy. The macroeconomic variables considered for this study are discussed in the following sections.

2.6.1 Inflation

Mukherjee & Naka (1995) investigated the rate of inflation and the Japanese stock market returns and established a negative relationship. Maysami et al. (2000) presented the same results after examining the Singapore stock market returns with the inflation rate measured in Consumer Price Index (CPI). They established a long-term equilibrium negative relationship.

Wongbangpo & Sharma (2002) further examined the macro variables' relationship with equity returns in selected ASEAN countries and concluded that the consumer price index has a short and long-run negative relationship with equity returns. They further observed that macro variables granger causes the stock market movements in all selected ASEAN countries indicating that the values of these indexes are functions of historical and present macro variables. Hsieh & Hodnett (2011) used the GARCH model to establish a relationship between South African JSE and selected macro variables and reported a negative relationship between JSE and the rate of inflation as well as the US government bond yield and nominal effective exchange rate.

According to Jaffe & Mandelker (1976), there is a negative relationship between inflation and stock market returns over short-term periods and positive returns over longer-term periods (1875-1970). Boudoukh and Richard (1993) confirm a positive relationship between stock returns and inflation, with Hess & Lee (1999) noting a demand shock emanating from an imbalance in aggregate demand and supply of the economy to be the cause of a positive relationship between inflation and stock returns.

Because stocks are derivatives or claims on real underlying assets, they are used to hedge against inflation (Bodie, 1976). This means that if the value of the underlying asset rises due to inflation, the price of the share should rise by the same amount, with no real change. According to Loannides et al. (2005), corporations can forecast their revenues, and as stocks represent claims on current and future earnings, it stands to reason that the stock market will operate as an inflation hedge in the long run. As a result, because the true worth of the stock market is already tied to the market's future price, it is immune to inflationary pressures.

South African literature also confirms that the stock market acts as an inflation hedge. Eita (2012) looked at the JSE results and concluded that South African stocks are an inflation hedge. All of these studies support the idea that inflation and stock performance are linked although displaying different results. Therefore, this paper included inflation as one of the macro variables to examine its impact on the stock market. As a result, the study observes conflicting results for the inflation variable, necessitating further investigation into its impact on the stock market.

2.6.2 Interest rates

Jefferis & Okeahalam (2000) did a cointegration analysis on the JSE using quarterly data from 1985 to 1995 and concluded that there is a long-run strong negative relationship between long-term interest rates and the JSE returns. Their study was confirmed by Ernest et al., (2016b) who posits that an increase in the interest rate paid by banks to depositors causes more investors to patronize banks and few to invest in the stock market.

Issahatu, Ustarz, and Domanban (2013) are of the idea that the stock market is the mediator between the lenders and borrowers and that it enables banks and other financial institutions to give credit facilities to individuals and firms at the prevailing rate. These, in turn, use funds to invest in the stock market and as a result, if the interest rates are high, such investments are discouraged. Van Rensburg (1999), however, had a different perspective, he asserted that if the Gordons's dividend discount model and the denominator of the expression are considered the required rate of return will be driven by the prevailing interest rate, and intuitively a negative relationship between interest rate variables and equity share prices.

The relationship between interest rates and stock returns remains uncertain, with other studies showing the insignificant influence of the former on the latter. Bernake and Binder (1992) posit that changes in interest rates can only significantly influence firms that are leveraged through debt. This may either liberate or constrain companies that are highly geared. Most of the companies listed on JSE are very conservative in their debt financing rendering the impact of changes in interest rates on the stock market insignificant.

Changes in interest rates, according to Ehrmann & Fratzscher (2004), are generally correlated with changes in business cycle conditions and other macroeconomic factors. They conclude that it is unclear what is due to changes in interest rates and what is due to changes in other economic variables. Du Toit & Moolman (2004) used an econometric model every quarter from 1978 to 2000 to confirm this study. They found that long-term interest rates have an impact on future stock market returns on the JSE, but that the degree of impact fluctuates depending on the business cycle in South Africa (Thorbecke, 1997). Stock returns in the United States react differently to interest rates based on the size of the company and the industry it works in.

According to Alam et al. (2009), there is a negative relationship between interest rates and share price, as well as changes in interest rates with changes in share price. It should be stressed, however, that there was no causation between interest rates and stock prices.

2.6.3 Exchange rates

Jefferis and Okeahalam (2000) found a long-run positive relationship between the JSE equity returns and the exchange rate. The USD/ZAR exchange rate was used for the study. Adjasi & Biekpe (2006) investigated seven African countries using cointegration analysis and concluded that, in the long run, exchange rate depreciation leads to an increase in the stock market returns. A negative relationship was established by Ajayi & Mougouė (1996b) after studying the relationship between exchange rates and eight developed economies. Their results indicate that currency depreciation has a negative relationship with equity prices. Their findings were validated by Kim (2003) and Maysami (2004).

Kutty (2010) states that the influence of exchange rates on stock market performance can be explained by two theories, the traditional approach, and the portfolio-adjusted approach. According to Solnik (1987) the traditional theory states that currency depreciation increases exports and hence companies' earnings increase which ultimately yields to share price increase. The portfolio adjustment approach on the other hand argues that the foreign capital inflows and outflows of a stock exchange are determined by the momentum. For example, if stock prices are going up in one country, they attract more capital inflows. Therefore, exchange rates are a lag factor. The study results confirm the negative relationship between the ZAR/USD exchange rate and ALSI, however, the underlying causality shows that there is no relationship between the ZAR/USD to the JSE.

Ajayi & Mougouė (1996a) concluded that there is no relationship between exchange rates and stock returns in Hong Kong, Thailand, Malaysia, or Singapore. Abdalla & Murinde (2010) also stated that there is no relationship in one South East Asian country, the Philippines. (Bhattacharya & Mukherjee, 2003) asserts that there is no significant relationship between stock returns and exchange rates in India.

2.6.4 Money Supply

Gunasekarage et al. (2016) tested macro variables and the All-share index for Sri Lanka Stock Exchange to establish if a long-term relationship exists. Their cointegration results reveal that there is a significant long-term relationship between the All-share index and the macro variables, specifically money supply and the treasury bill rate. Humpe & Macmillan (2007) tested for a long-term relationship between money supply, industrial production, and long-term interest rates and concluded that money supply is positively related to equity prices.

Hsing (2011), Gupta & Modise (2013) examined the influence of money supply in the JSE All-share index, and their studies reveal that money supply may increase due to inflation and may have a negative impact on stock price, it must be noted, however, that their empirical evidence states that increase in money supply creates excess liquidity in the market which in turn leads to excess demand for equity through portfolio allocation and result in a stock price increase.

The studies that argued that money supply has a negative relationship with stock market returns build their argument based on previous studies in ASIAN countries (Ibrahim & Aziz, 2003a), (Wongbangpo et al., 2002) and Humpe and MacMillan (2007) studies. Their research was speculative in that a possible reason for a negative relationship was that the money supply may increase due to inflation and as a result may have a negative relationship.

However, more study has been done, and these studies have found a positive association between money supply and inflation. According to this reasoning, an increase in the excess money supply may lead to an increase in equity demand via portfolio allocation, resulting in a rise in share prices. More money in the market, according to Mukherjee and Naka (1995), has an expansionary influence on the economy, which enhances corporate earnings and has a favorable long-run association with the stock price.

South African monetary policy, as well as other macroeconomic factors, were inconsistent, according to Aron, Elbadawi, and Kahn (2000). For example, in certain times, the primary goal was to maintain the balance of payments, while in others, the key goal was to keep inflation under control. As a result, these diverse policy objectives have varied ramifications for money supply and JSE performance. The De Kock Commission (1984) argued that the contradictory monetary, fiscal, exchange rate and political policies that were often moving in opposite directions were the influence that may conceivably demonstrate a meaningful relationship. As a result, even if the policy goal was to grow or decrease the money supply, the conflicting nature of other policies precluded the possibility of either a long-term or short-term link.

2.6.5 Foreign Equities

Moolman and Du Toit (2004) used JSE returns to perform cointegration and vector error correction to see if there was a long-term relationship between JSE performance and economic fundamentals. According to studies, there is a short-term association between JSE returns and the S&P500 index in the United States, with a long-term relationship for certain economic factors. Paul Van Rensburg (1995) used bivariate Granger causality tests to estimate the relationship between JSE equity returns and unexpected S&P500 returns, unexpected changes in term structure, changes in gold prices, and changes in inflation, and the results show that these four factors have an impact on FTSE/JSE stock returns. The researcher will also test how the MSCI World Index affects the JSE's Index levels to capture the influence of overseas stock markets.

2.6.6 Earnings

According to Gordon & Shapiro's (1956) dividend discount model, the value of the business is influenced by the current dividend and the sum of expected future dividends. Miller & Modigliani (1961a) however, argued that companies can only increase the dividends pay out if they made high earnings, and ultimately the value of the business is derived from the earnings since dividends are paid from earnings.

The dividend's growth rate is the same as earning's growth rate provided that the business uses internal financing only (Miller & Modigliani, 1961b). Now that the impact of earnings on the equity price has been established, it is important to measure the cointegration between the four major JSE index earnings yield (ALSI, Financial Top 15 Index, Resource Top 10 Index, and the Industrial Top 25 index) and FTSE/JSE major indices to establish if the long-term relationship exists. The index earnings were computed as follows (equation 2).

$$AE = [E/P]_{ALSI} * ALSI \quad (3)$$

Where:

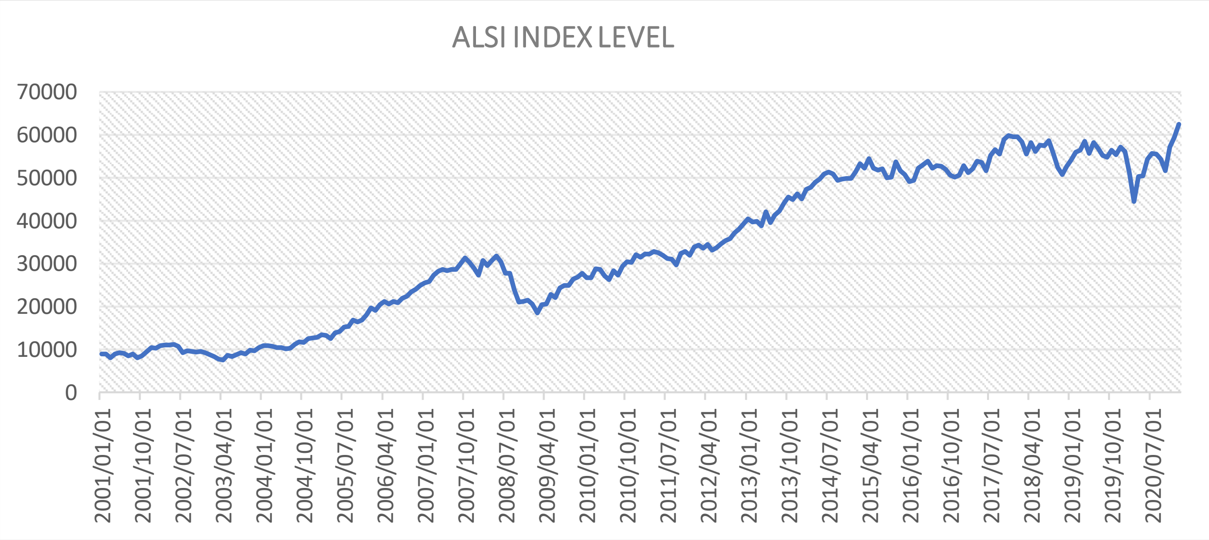
AE – Indexed Earnings

$[E/P]_{ALSI}$ - Earnings of ALSI

ALSI – All Share Index Level

Figure 1 shows ALSI index levels for the period under consideration, part of the index level changes is due to macroeconomic variables changes.

Figure 1. FTSE/JSE All Share Index Levels



Source: Bloomberg

The ALSI represents 99% of the full market capitalization value of all ordinary shares listed on the JSE main board. This index movement consists of three major sectors, the Resource sector, the Financial sector, and the Industrial sector. The research will establish the long-term relationship between ALSI (J203), RES (J210), FINI (211), and INDI (J212) earnings and the performance of all major indexes among other factors which influence the share price movement.

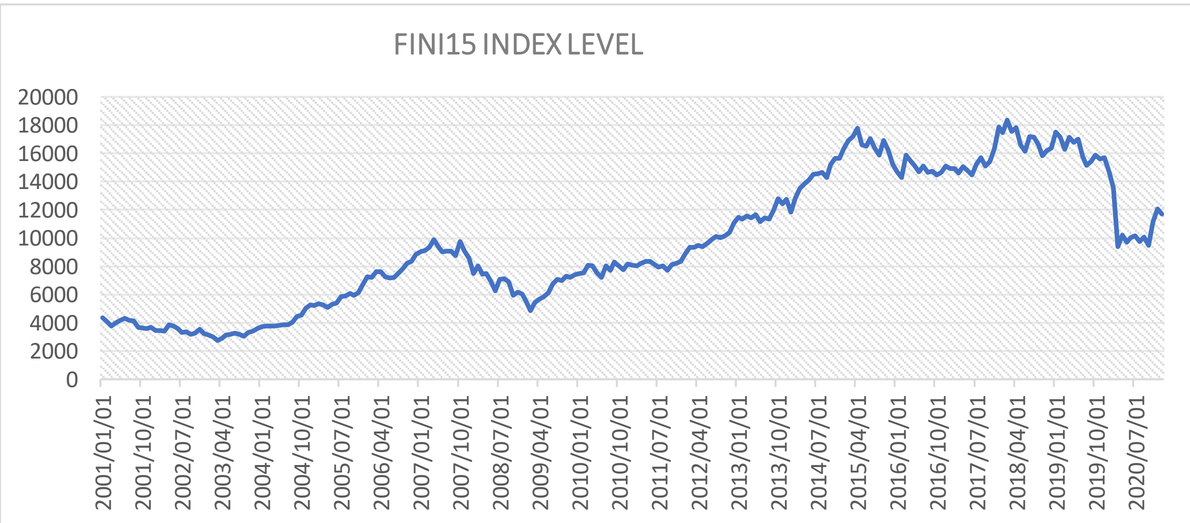
Figure 2. FTSE/JSE Resource 10 Index levels

The FTSE/JSE Resource 10 index initially had the 20 largest ALSI companies as constituents when ranked by market cap, the index level changes are shown in figure 2 below.

Source: Bloomberg

In March 2011, it was then superseded by the Resource 10 index with the 10 largest ALSI resource companies as the constituents. These companies are ranked by investable market capitalization (IC Industry 0001 Oil and Gas and 1000 basic Materials). This is the most capitalized sector in All Share Index, earnings and has a huge influence on the JSE performance.

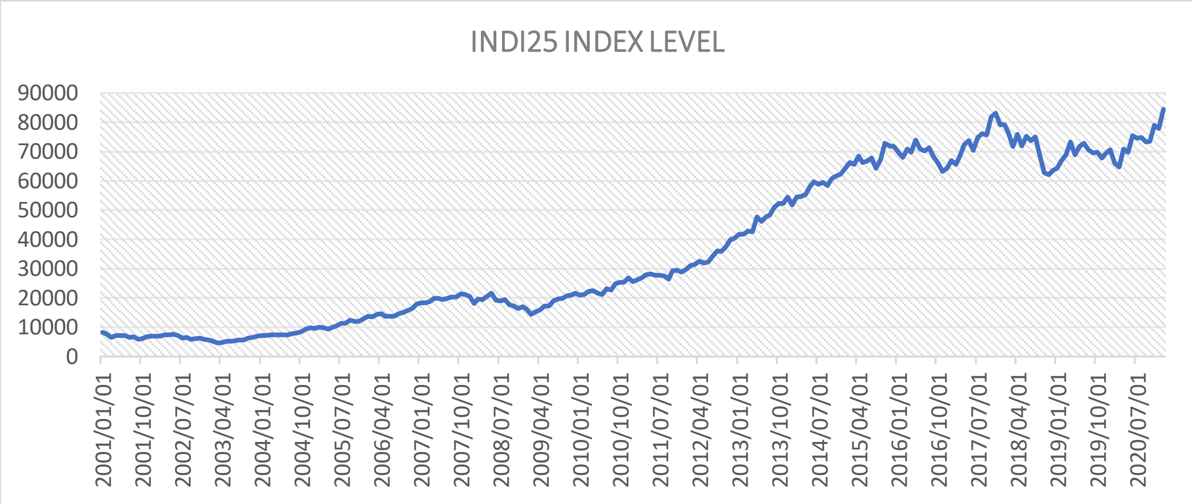
Figure 3. FTSE/JSE Financial 15 Index levels



Source: Bloomberg

The FINI Top 15 is part of the large, capitalized sector and it has been showing growth trends since 2017 December, although the global economic meltdown did not spare the index during the March 2020 meltdown caused by the covid 19 pandemic. Figure 3 shows index level changes for 20 years.

Figure 4. FTSE/JSE Industrial 25 Index levels



Source: Bloomberg

INDI Top 25, of the companies listed on the JSE, INDI takes up the biggest positions and the most space, this explains why the above graph trends are like the ALSI graph in figure 1.0. this is large because industrial companies pay a good dividend, and most portfolios are likely to include at least one industrial sector company.

Chapter 3

3.1 Problem statement and Hypothesis

A wealth of literature exists concerning the modelling of stock markets and the relationship between share prices and different economic variables (Banda, Hall and Pradhan, no date; Fama and Schwert, 1977; Moolman, Bank and Du Toit, 2005; Rashid, 2008; Ssekuma, 2011; Majid, 2016). However, most studies use data from developed markets while studies modelling emerging markets like South Africa is very limited and no structural, theoretically founded model of JSE has yet been developed and estimated. In this study, theoretically grounded, structural model of JSE was explored using DDM, cointegration techniques and ECM, the intention of the study was to expose the macroeconomic variables that impact JSE share price movement as well as the intensity of their impact. This research adds on previous studies by Van Rensburg (1995, 1998, 1999) and Barr and Kantor (2002) that analysed the structural determinants of the JSE, and it considers more recent timeframe, which is between January 2001 and January 2021. The paper will also address the impact of selected index earnings on the ALSI (J203), RESI (J210), FINI (J211), INDI (J212), DJIA, and MSCI world index. The research seeks to answer the following questions.

3.2 Research Question (Main Research Question)

Is there a cointegrating relationship between asset prices and the underlying macroeconomic variables ?

Null Hypothesis: There is no cointegrating relationship between stock market index and the macroeconomic variables.

Alternative Hypothesis: There is a cointegrating relationship between stock market index and the macroeconomic variables.

Asset classes that were looked at are Bonds and Equities. In particular, the All-Bond Index (ALBI), All Share Index (ALSI), Resource Top 10 Index, Financial Top 15 Index, Industrial Top 25 Index, MSCI World Index, and Dow Jones Industrial Average (DJIA) will be considered.

3.3 Data

The researcher collected data from Bloomberg, an information service that supplies real-time and historical market data. The period under consideration is January 2001 to January 2021. Data was verified through I-Net Bridge to ensure its correctness.

The closing monthly prices for ALSI, RESI 10, FINI 15, ALBI, MSCIW, DJIA, and INDI 25 were exported to Microsoft Excel from Bloomberg. The study made use of monthly data. The selected Index earnings yield data was also exported from Bloomberg every month. The Resource 10 index was selected as a proxy for the movement of all JSE resource share prices. Industrial 25 was selected to proxy the movement of all prices of shares classified as industrials by the JSE. The Financial 15 index was used as a proxy for the JSE financial sector share price movement. DJIA and MSCIW will proxy the influence of the international stock market on JSE.

The index earnings will be computed by dividing index earnings per share by the index level (Price) and then multiply by the index level so that we get our index earnings as shown in equation 2. The macro variables are released monthly by the national statistics of South Africa. The interest rates used in this research will be real rates from the 90 days Treasury bill rate and the 10-year government bond rate. Consumer Price Index (CPI) will be used as a measure of monthly inflation and the exchanged rate, being the ZAR price per USD, and money supply will be according to SARB M3 supply publications.

3.4 Methodology

The study modelled long term and short-term cointegration of the stock market index separately with the cointegration equation and the ECM respectively. Variables are cointegrated if they have a common trend or a degree of resemblance in terms of long-term oscillations; however, this does not imply that they constantly move together or are connected.

Table 1 shows macroeconomic variables and JSE indices considered for this study.

Table 1. Explanatory and dependent variables

	Independent variables	Dependent variables
1	SA Consumer Price Index (Inflation)	ALSI
2	US Consumer Price Index (Inflation)	RESI 10
3	Money Supply (M3)	FINI 15
4	3 Months Treasury Bills rate	ALBI
5	10-year Government Bond	MSCIW
6	Exchange Rate (USD/ZAR)	DJIA
7	Financial Index Top 15 Earnings (FINIE)	INDI 25
8	Resource Index Top 10 Earnings (RESIE)	
9	Industrial Index Top 25 Earnings (INDIE)	
10	All Share Index Earnings (ALSI)	
11	MSCI World Index Earnings	
12	Foreign Stock Index (DJIA) Earnings	

The number of observations and the length of the study period were both factors in determining long-run relationships and subsequent inferences from cointegration (Zhou et al., 2001). In addition, Zhou (2001) claims that using small samples of 30 to 50 annual observations rather than observations of higher frequency data may result in a loss of test power and a significant amount of data distortion. According to studies, a test with a short time horizon and few observations produces findings that are highly sensitive to the lag duration utilized and are affected by under-parameterization. This study will avoid these issues by employing a 20-year time frame and monthly frequency data with a short lag duration.

Maysami and Koh (2000) posit that a set of time series data is cointegrated if they are integrated of the same order and a linear combination of the variables is stationary. Granger (1986) and Johansen & Juselius (1990) agree that the presence of such a linear combination points to the existence of a long-run relationship among the variables being tested. It is for this reason that the study performs Augmented Dickey-Fuller (ADF) test for stationarity to establish if the variables are integrated of the same order before performing a cointegration test. The general formula for ADF is based on equation 1.

$$\Delta \pi_t = \alpha + \beta_t + V \pi_{t-1} + \alpha \pi_{t-1} + \Sigma \Phi\Delta \pi_{t-j} + V \quad (1)$$

Stationarity, according to Challis and Kitney (1991), is the quality of a process in which statistical metrics like mean, standard deviation, and autocorrelation do not change with time and are solely dependent on the lag at which the function was determined.

Nonstationary data, according to Verbeek (2009), produces a spurious regression model. Josh and Shukla (2009) further assert that when dealing with non-stationary data, the test statistics ratios do not follow a t distribution and the series will consistently increase over time. The sample mean and variance will grow with the size of the sample undermining the mean and variance for future periods thereby causing a spurious regression. Harris (1994) states that due to spurious regression which might be caused by non-stationary data when doing a time series analysis using cointegration, testing for stationarity is almost mandatory.

The augmented dickey fuller test is conducted with the assumption that the null hypothesis represents nonstationary data, and the alternative hypothesis shows stationary data. If the T statistic is less than the critical value and the p-value is less than 0,05, then the null hypothesis which states that data is nonstationary will be rejected and the alternative hypothesis which states that data is stationary will be accepted.

After establishing the order of integration for the variables, an optimal lag length for the model to avoid model misspecification was selected using Akaike's information criterion (AIC) and Schwarz information criterion (SIC). The optimal lag length, which minimizes the values of AIC and SIC, can be estimated using AIC, Akaike's (1973), or (SIC), Schwarz (1978) among others, lag length.

3.5 Cointegration and Error Correction Model (ECM)

In comparison to the Vector Autoregressive model, a cointegration test was run on EViews 11 software. Cointegration is commonly used to study the relationship between asset prices and macro factors, and it is more favourable in that it may examine dynamic co-movements among the variables using an Error Correction Model (ECM), according to Mukherjee and Nakamura (1995).

ECM has proved to be attractive in that it encompasses models in both levels and differences in variables and is compatible with long-run equilibrium behaviour.

For this study, a simple model where π_t and ϕ_t are both nonstationary was considered.

Step 1: Test each variable to determine the order of integration. ADF tests can be applied to infer the number of unit roots in each variable as shown in equation (1).

Step 2: If the results in equation (1) indicate that both π_t and ϕ_t are integrated of the same order then the long-run equilibrium relationship of equation (2) and extract residual process (z_t) will be estimated.

Step 3: Do Engle and Granger test by running the cointegrating regression, that is the long-run relationship test using the OLS and test the estimated residual (z_t) for stationarity. If the estimated residuals are indeed stationary, it implies that $\pi_t = \alpha + \phi_{et} + z_t$ have long run relationship.

$$\pi_t = \alpha + \phi_{et} + z_t \qquad (2)$$

To test the existence of cointegration between two series, the Engle-Granger's Augmented Dickey Fuller cointegration test will be used. This will be done by testing for unit roots in the residual process using equation (3).

$$\Delta\hat{Z}_t = \alpha + \text{V}z_{t-1} + \Sigma\phi\Delta z_{t-j} + \text{V} \qquad (3)$$

H_0 : V = 0 (No existence of a cointegration relation)

H_1 : V < (Existence of a cointegration relation)

If the relationship between $\boldsymbol{\pi_t}$ and $\boldsymbol{\phi_t}$ is linear and stationary, then these two variables are cointegrated and it implies that estimated residuals might be stationary.

The null hypothesis of non-cointegration will be rejected if the McKinnon statistic is greater than the corresponding critical value in absolute terms (Ssekuma, 2011). Otherwise, there will be no long-term relationship between the variables considered.

Step 4: If the residuals from the equilibrium regression are cointegrated, that stationary at levels, then they can be used to estimate the error correction term and to analyze the long-run and short-run effects of macro-economic variables on the stock market index levels (Pinshi and Pinshi, 2020). The ECM describing the relationship between macro variables and stock market index levels is written as equation 4.

$$\Delta\pi_t = \beta_0 + \Sigma\beta_j \Delta\Phi_t + \Sigma\, \text{У}(\pi_t - \phi\varepsilon_t - \alpha) + \mu_t \qquad (4)$$

β_0 – Constant term which allows for the depiction of a random walk with drift and is appropriate in all cases where the mean is not zero.

$\Sigma\beta_j\ \Delta\Phi_t$: This parameter represents the short-run dynamics of stock market index levels relative to macro-economic variables.

$\pi_t - \phi\varepsilon_t - \alpha$: This term can be symbolized in z_{t-1} as the delayed error term. It represents the magnitude of imbalance between the level of stock market index levels and macroeconomic variables in the previous period. The ECM indicates that the changes in π_t depend not only on the changes in π_t but also on the magnitude of imbalance that is z_{t-1}. Equation (4) can be rewritten as:

$$\Delta\pi_t = \beta_0 + \Sigma\beta_j\ \Delta\Phi_t + \Sigma\ Уz_t + \mu_t \qquad (5)$$

3.6 Impulse Response Function (IRF)

After ECM is performed, the study evaluated impulse response functions based on the VAR model to depict the dynamic interactions among variables as Wongbangpo and Sharma (2001) posited. These studies were also confirmed by Ibrahim & Aziz, (2003b). Given that all variables on VAR depend on each other, individual coefficients estimate only provide a limited explanation of the reaction of the system to a shock, to get a more precise reaction of the model's dynamic behavior we make use of impulse responses.

The shock to the i-th variable in a VAR model impacts not only the i-th variable but also the other endogenous variables through the dynamic lag structure (Stefan & van Rensburg, 2019). The stock market's response to a one-time positive standard deviation shock in endogenous variables is tracked by the impulse response function. As a result, the impulse response function depicts the ALSI, RESI10, FINI15, INDI25, ALBI, and US Aggregate Bond Index reaction in macroeconomic indicators, index earnings, and international stock market performance at the time of the shock and later periods as a function of time to the shock. This test reveals the direction, speed, and durability of the JSE's short-term reaction to innovations or changes in candidate variables. The speed at which JSE indices respond to economic shocks can be interpreted as a measure of its efficiency according to equations 6,7 and 8.

$$Y_t = C + A_1\, Y_{t-1} + A_2\, Y_{t-1} + \ldots\ A_p\, Y_{t-p} + \varepsilon_A \qquad (6)$$

$$Y_t = C + \acute{\varepsilon}_t + \partial_1\, \varepsilon_{t-1} + \partial_2\, \varepsilon_{t-2} + \ldots\ = \pounds\ (\beta)\ \varepsilon_t \qquad (7)$$

$$\frac{\partial yt-1}{\partial \varepsilon t} = C_j \quad (8)$$

According to Naka & Tufte (1997), there are two methods of deriving IFRs, and these are a VAR model in levels with one lag (Conventional method) and an equivalent VECM method where vector cointegration parameters are constrained. For this study, conventional methods will be used because the estimation of VAR is simpler that the estimation of VECM.

3.7 Variance Decomposition

After establishing the existence of long-run co-movement between the JSE and selected explanatory variables, the question of how much of the JSE volatility is explained by the volatility of each candidate factor and by the JSE volatility itself inevitably arises. The variance decomposition model will be used to solve this question. The variance decomposition demonstrates how much influence each element has on JSE index volatility. The function also illustrates how much of the JSE's movement is due to the JSE's volatility. The function, in general, displays how much of the forecast error variance for every variable in the VAR is explained by each independent variable's innovations.

According to Sims (1980), variance decompositions are constructed from a VAR with orthogonal residuals and as a result, they can directly address the influence of macro variables, index earnings, and foreign stock market movements in forecasting the variance of the stock prices.

Enders (1995) asserts that the proportion of Y variance due to X can be expressed as equation 9.

$$\frac{\mu^{\wedge 2}[\mathrm{aij}(0)^{\wedge 2} + \mathrm{aij}(1)^{\wedge 2} + \cdots \mathrm{aij}(\mathrm{n}-1)^{\wedge 1}]}{\mu y(n)^{\wedge 2}} \quad (9)$$

Enders (1995) defines aid as the coefficients of lagged values of variable j on variable I with n representing the prediction horizon. Enders and Gan et al. (2006) further posit that as the n period increases $\mu y(n)^2$ also, increase.

Chapter 4

4.1 Results

The results from the methodology in chapter three are tabled, graphed, and interpreted in this section.

Table 2. Variable Labels

Table 2 shows the interpretation of both dependent and independent variables, the abbreviations were used throughout this paper.

Variables	Labels
LOG ALBI	All Bond Index Natural Log
LOG ALSI	All Share Index Natural Log
LOG ALSIE	All Share Index Earnings Natural Log
LOG DJIA	Dow Jones Industrial Average Natural Log
LOGDJIAE	Dow Jones Industrial Average Earnings Natural Log
LOG FINI15	Financial Index Top 15 Natural Log
LOG FINI15E	Financial Index Top 15 Earnings Natural Log
LOG INDI25	Industrial Index Top 25 Natural Log
LOG INDI25E	Industrial Index Top 25 Earnings Natural Log
LOG MSCIW	Morgan Stanley Capital International World Natural Log
LOG MSCIWE	Morgan Stanley Capital International World Earnings Natural Log
LOG RESI10	Resource Top 10 Index Natural Log
LOG RESI10E	Resource Top 10 Index Earnings Natural Log
LOG 10YSAGB	10-Year South African Government Bond Natural Log
LOG SACPI	South African Inflation Natural Log
LOG SAM3	South African Money Supply Natural Log
LOG USDZAR	Exchange Rate
LOG SA3MTB	3 Months South African Treasury Bill Natural Log
LOG USCPI	U.S Inflation Natural Log

Before performing a cointegration test, the data were tested for stationarity using ADF with constant and trend. Macfarlane and West (2013) assert that share prices follow a random walk with drift and are unlikely to be stationary in levels. This was further proved by Rizwanullah *et al.* (2020) who concluded that stock market prices are not stationary at levels after using Augment Dickey-Fuller (ADF) test to test for stationarity for 6 Asian countries.

The time series data were logged before performing ADF tests on EViews. This is because it is a convenient means of transforming data into a normalized dataset and eliminating autocorrelation issues. The optimal lag selection was determined by SIC criteria on EViews with a maximum lag of 14. The maximum lag was specified to meet monthly data requirements.

Table 3. Test for Stationarity

Variables	Augmented Dickey-Fuller (Levels)		Augmented Dickey-Fuller (1st Difference)	
	t-Statistic	***Prob****	***t-Statistic***	***Prob****
LOG ALBI	-1.470837	0.5469	-16.43269	0.0000
LOG ALSI	-1.260821	0.6480	-15.94590	0.0000
LOG ALSIE	-1.787955	0.3860	-14.61319	0.0000
LOG DJIA	0.191216	0.9716	-14.55916	0.0000
LOG DJIAE	-0.979437	0.7595	-11.64737	0.0000
LOG FINI15	-1.165107	0.6898	-15.37057	0.0000
LOG FINI15E	-1.479519	0.5425	-14.45946	0.0000
LOG INDI25	-0.345330	0.9147	-15.43470	0.0000
LOG INDI25E	-0.414153	0.9033	-15.56209	0.0000
LOG MSCIW	-0.224139	0.9321	-13.56315	0.0000
LOG MSCIWE	-2.413993	0.1389	-4.678541	0.0001
LOG RESI10	-2.210917	0.2030	-16.35096	0.0000
LOG RESI10E	-1.637934	0.4616	-13.76162	0.0000
LOG 10YSAGB	-3.351052	0.0137	-16.59390	0.0000
LOG SACPI	-0.354544	0.9132	-9.856831	0.0000
LOG SAM3	-1.493407	0.8295	-15.20362	0.0000
LOG USDZAR	-0.819568	0.8114	-15.48323	0.0000
LOG SA3MTB	-2.007423	0.2836	-6.914749	0.0000
LOG USCPI	-1.385521	0.5892	-10.59619	0.0000

Note: Prob is 5% significance*

Concerning table 3, the unit root tests were performed using ADF on EViews software and we failed to reject the null hypothesis which states that the time series data has unit roots at a 5% level of significance. The data was then first differenced and unit roots tests using ADF have performed again. The null hypothesis was rejected at a 5% level of significance and further, the t-statistic values for ADF in absolute terms were greater than test critical values as shown in table 3, this meant that at the first difference the variables do not have unit roots (stationary)

Table 4. Descriptive Statistics

Table 4 shows the logged dependent and independent variables of stationary descriptive statistics.

Variables	Mean	Median	Maximum	Minimum	St. Deviation
LOG 10YSAGB	2.1716	2.1647	2.5579	1.8499	0.1244
LOG ALSI	10.2386	10.3525	11.0425	8.9240	0.6468
LOG ALSIE	7.4999	7.6909	8.1729	6.3698	0.5130
LOG DJIA	9.5402	9.4441	10.3289	8.8626	0.3682
LOGDJIAE	6.7199	6.7709	7.4111	5.9657	0.3722
LOG FINI15	9.0446	9.0758	9.8175	7.9172	0.5382
LOG FINI15E	6.5593	6.6339	7.2993	5.5573	0.4839

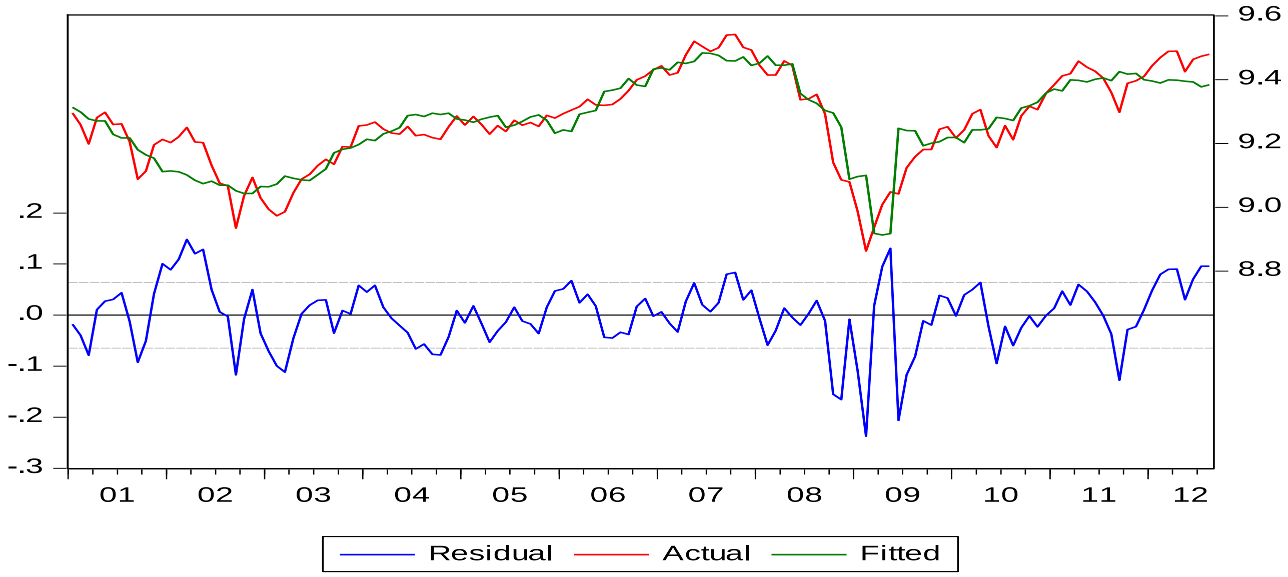
LOG INDI25	10.1585	10.1774	11.3441	8.4380	0.8991
LOG INDI25E	7.2955	7.2774	8.1175	6.1355	0.5779
LOG MSCIW	7.2412	7.2250	7.8973	6.6041	0.2996
LOG MSCIWE	4.2903	4.4450	4.8641	3.1141	0.4029
LOG RESI10	10.4958	10.6485	11.1995	9.4722	0.4215
LOG RESI10E	7.8264	7.8829	8.6589	6.9400	0.4385
LOG ALBI	5.8029	5.8325	6.6395	4.7627	0.5074
LOG SACPI	4.3725	4.3629	4.8586	3.8687	0.5903
LOG SAM3	14.4179	14.5502	15.2475	13.1656	0.5903
LOG USDZAR	2.2461	2.1483	2.9192	1.7343	0.3111
LOG SA3MTB	1.9689	1.9684	2.5399	1.0747	0.2907
LOG USCPI	5.3863	5.3990	5.5691	5.1682	0.1171

4.2 Cointegration Test Results

Stock market index levels series and macroeconomic series were tested for stationarity as shown in **table:4** and they were all found to be stationary in the first difference. Since the variables were integrated in the same order, their logs were then regressed using Least Squares and the results are shown below (**Table: 5 to Table 11**).

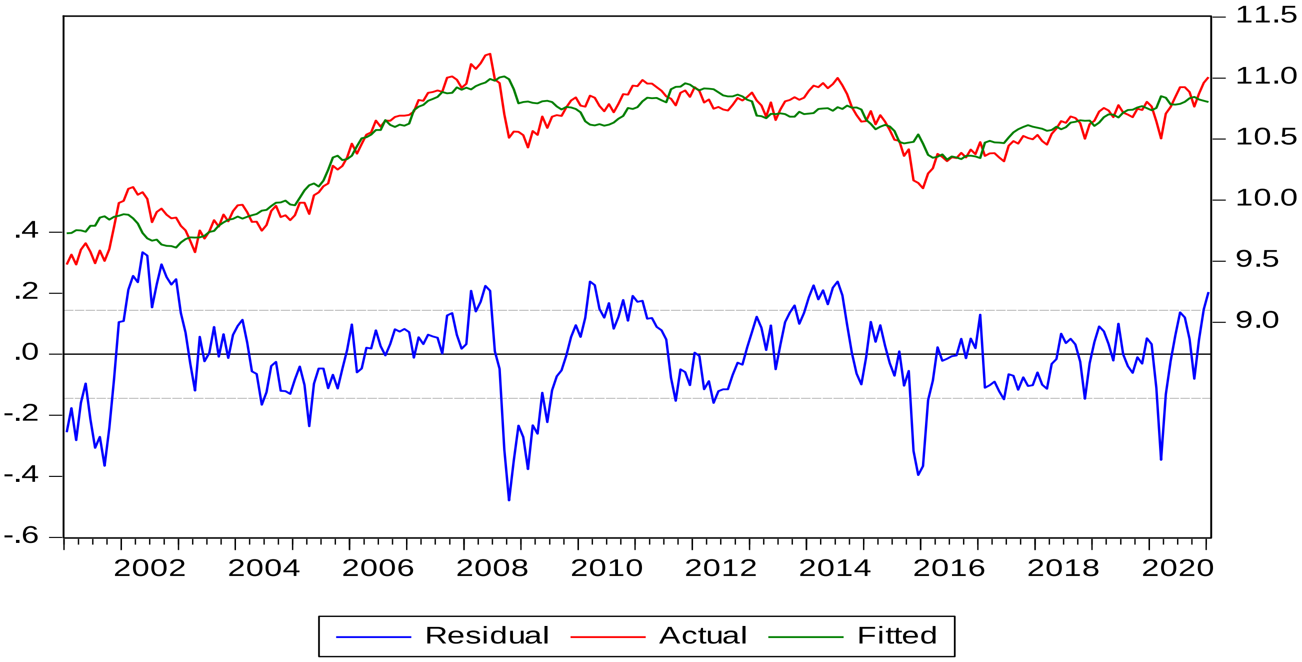
Before running the Least Squares regression, to verify if the model does not violet the linearity and normality test, Actual fitted residual graphs were plotted as shown in Figures 5 and 6.

Figure 5. DJIA Actual Fitted Residual



Source: Research findings

Figure 6. Actual Fitted Residual RESI10



Source: Research findings

Figure 5 and 6 show actual fitted residual for DJIA and RESI10 confirming that the index level data are randomly scattered around the residual meaning that the Least Squares regression does not violet linearity requirement of time series and that the data is stationary rendering the model appropriate for this study.

4.2.1 Regression test results

Table 5. ALBI

Variables	Coefficients	Std. Error	*t-Statistic*	*Prob*
Constant	-5.870436	0.776049	-7.564516	0.0000
LG10YSAGB	-0.423401	0.026492	-15.98204	0.0000
LGSA3MTB	-0.096681	0.010774	-8.973598	0.0000
LGSACPI	1.071694	0.050720	21.12965	0.0000
LGSAM3	-0.076532	0.038128	-2.007243	0.0459
LGUSCPI	1.708139	0.250861	6.809111	0.0000

Table 6. ALSI

Variables	Coefficients	Std. Error	*t-Statistic*	*Prob*
Constant	-27.87148	1.920122	-14.51547	0.0000
LG10YSAGB	-0.568428	0.095611	-5.945226	0.0000
LGUSDZAR	0.368871	0.067924	5.430654	0.0000
LGUSCPI	8.244545	0.494153	16.68418	0.0000
LGSACPI	-1.403892	0.219631	-6.392060	0.0000
LG3MTB	0.125465	0.036829	3.406741	0.0008

Table 7. DJIA

Variables	Coefficients	Std. Error	*t-Statistic*	*Prob*
Constant	0.443299	1.208980	0.366672	0.7144
LGDJIAE	0.619568	0.041096	15.07598	0.0000
LG10YSAGB	0.180589	0.061235	2.949134	0.0038
LGUSCPI	1.730697	0.328250	5.272501	0.0000
LGSACPI	-1.144936	0.131496	-8.706986	0.0000

Table 8. MSCIW

Variables	Coefficients	Std. Error	*t-Statistic*	*Prob*
Constant	-7.383761	1.791891	-4.120653	0.0001
LGMSCIWE	0.405371	0.036504	11.10473	0.0000
LG10YSAGB	0.301819	0.092652	3.257553	0.0013
LGUSDZAR	0.179443	0.049012	3.661200	0.0003
LGUSCPI	3.744206	0.665715	5.624336	0.0000
LGSAM3	-0.578419	0.120967	-4.781626	0.0000

Table 9. FINI15

Variables	Coefficients	Std. Error	*t-Statistic*	*Prob*
Constant	-15.02401	2.407831	-6.239644	0.0000
LGFINI15E	0.413610	0.053252	7.766972	0.0000
LG10YSAGB	-0.890864	0.095219	-9.355958	0.0000
LGUSCPI	6.100772	0.883316	6.906674	0.0000
LGSAM3	-0.684192	0.162473	-4.211106	0.0000
LGSA3MTB	0.149515	0.053382	2.800870	0.0055

Table 10. RESI10

Variables	Coefficients	Std. Error	*t-Statistic*	*Prob*
Constant	-20.06652	3.067609	-6.541420	0.0000
LGRESI10E	0.269476	0.027979	9.631375	0.0000
LG10YSAGB	0.307034	0.103249	2.973709	0.0032
LGUSCPI	5.057770	0.993178	5.092512	0.0000
LGSACPI	-3.142770	0.224304	-14.01121	0.0000
LGSAM3	0.990832	0.145251	6.821523	0.0000

Table 11. INDI25

Variables	Coefficients	Std. Error	*t-Statistic*	*Prob*
Constant	-15.81596	1.125663	-14.05035	0.0000
LGINDI25E	0.521712	0.052709	9.897911	0.0000
LG10YSAGB	-0.648403	0.115286	-5.624306	0.0000
LGUSDZAR	0.349225	0.066384	5.260707	0.0000
LGUSCPI	4.231483	0.246326	17.17835	0.0000

After testing all the variables for regression using Least Squares as shown in the **table: 5 to table 11,** the next step was to check if the variables are cointegrated. All the insignificant independent variables were removed from the series and regressed all the significant independent variables against the stock market index levels using OLS of the equation (2) form.

The OLS Durbin-Watson test for all the regressed variables was less than 2, suggesting that there is an existence of positive autocorrelation between index levels and macroeconomic variables. However, the first differenced variables have a Durbin-Watson test of 2 meaning that at the first difference, the variables do not have autocorrelation. R-Squared was more than 85% for all regressed variables indicating that the model better explains the relationship between index levels and macro variables.

The residuals were extracted from the regressed series and tested for unit root using the ADF test of the equation (3) form, The null hypothesis of non-cointegration was rejected since the t-statistic of ADF is greater than the corresponding critical values in absolute terms and less than 0. **Table:12** show results for residuals unit root tests that rejected the null hypothesis of non-cointegration at levels, and further, the p-value is less than 5% meaning the series has a long-run dynamic relationship. The existence of market equilibrium confirms the fair value model coined by Gordon and Shapiro (1956).

Table 12. Cointegration tests results

Variables	*t-Statistic***	*Prob**
LGALBI	-2.337475	0.0191
LGALSI	-3.684065	0.0049
LGFINI15	-3.757870	0.0039
LGRESI10	-4.803799	0.0001
LGINDI25	-3.265479	0.0176
LGMSCIW	-4.003964	0.0017
LGDJIA	-6.107270	0.0000

**MacKinnon (1996) one-sided p-values, note ** denotes a 95% level of significance*

The presence of the long-term dynamic relationship of macroeconomic variables with stock market index levels was confirmed by a study that sought to establish the presence of a cointegrating relationship between macroeconomic fundamentals and stock market prices in South Africa, Botswana, and Zimbabwe (Southern Africa, Jefferis, and Okeahalam, 2010). The study used quarterly data between 1985 and 1995 and concluded that in the long run, stock prices are positively related to GDP and exchange rates while a negative relationship was observed with long-term interest rates and inflation. South African stock market is influenced by the expected present value model, which in turn means that it is driven in the long run by macroeconomic variables (Moolman, Bank, and Du Toit, 2005). The same study further asserted that share price level, in the long run, is determined by discounted future dividends, cemented by the cointegrating relationship that exists.

The existence of long-term relationship paves the way for the estimation of ECM on **table: 13** below.

Table 13. Error Correction Model

Variables	Coefficients	Std. Error	*t-Statistic*	*Prob*
LGALBI RES (-1)	-0.044047	0.018844	-2.337475	0.0202
LGALSI RES (-1)	-0.102139	0.027725	-3.684065	0.0003
LGFINI15 RES (-1)	-0.098255	0.026147	-3.757870	0.0002
LGRESI10 RES (-1)	-0.173457	0.036108	-4.803799	0.0000
LGINDI25 RES (-1)	-0.081420	0.024934	-3.265479	0.0013
LGMSCIW RES (-1)	-0.135975	0.033960	-4.003964	0.0001
LGDJIA RES (-1)	-0.435916	0.071377	-6.107270	0.0000

Note: (-1) is the previous period (one month lag)

To estimate the short-term and long-term dynamics of macroeconomic variables on the changes in a stock market index, one can use ECM. The advantage of ECM formulation is that it combines flexibility in dynamic specification with long-term desirable properties (Engle and Granger, 2015). The ECM uses previous period (-1) macro-economic data to predict stock market index level deviation from the long-run equilibrium. Table 13 shows stock market index levels as delayed error terms between the index levels and the macro-economic variables in the previous period [month (-1)]. The error correction expresses the speed by which stock market prices adjust towards the long-term market equilibrium, it must be negative and significant as shown in Table 7 and as indicated by the ALBI illustration in equation (11).

ALBI illustrates how changes depend on the magnitude of the imbalance of error terms (Table 13).

With reference to equation (4), the ALBI error correction term will have the following structure:

$$\Delta\pi_t = \beta_0 + \Sigma\beta_j\,\Delta\Phi_t + \Sigma\,У(\pi_t - \phi\varepsilon_t - \alpha) + \mu_t \qquad (10)$$

$$ALBI_{(-1)} = \beta_0 + \Sigma\beta_j\,\Delta\Phi_t - 0.044047z + 0{,}018844\mu. \qquad (11)$$

The slope coefficient of У in **equation (11)** implies that if in the preceding period (-1) the level of ALBI was 1% higher than that predicted by the long-term market equilibrium ratio then there will be an adjustment to reduce the ALBI level by У or -0.0044047 during this period to restore the long-run market equilibrium relationship between ALBI level and macroeconomic variables.

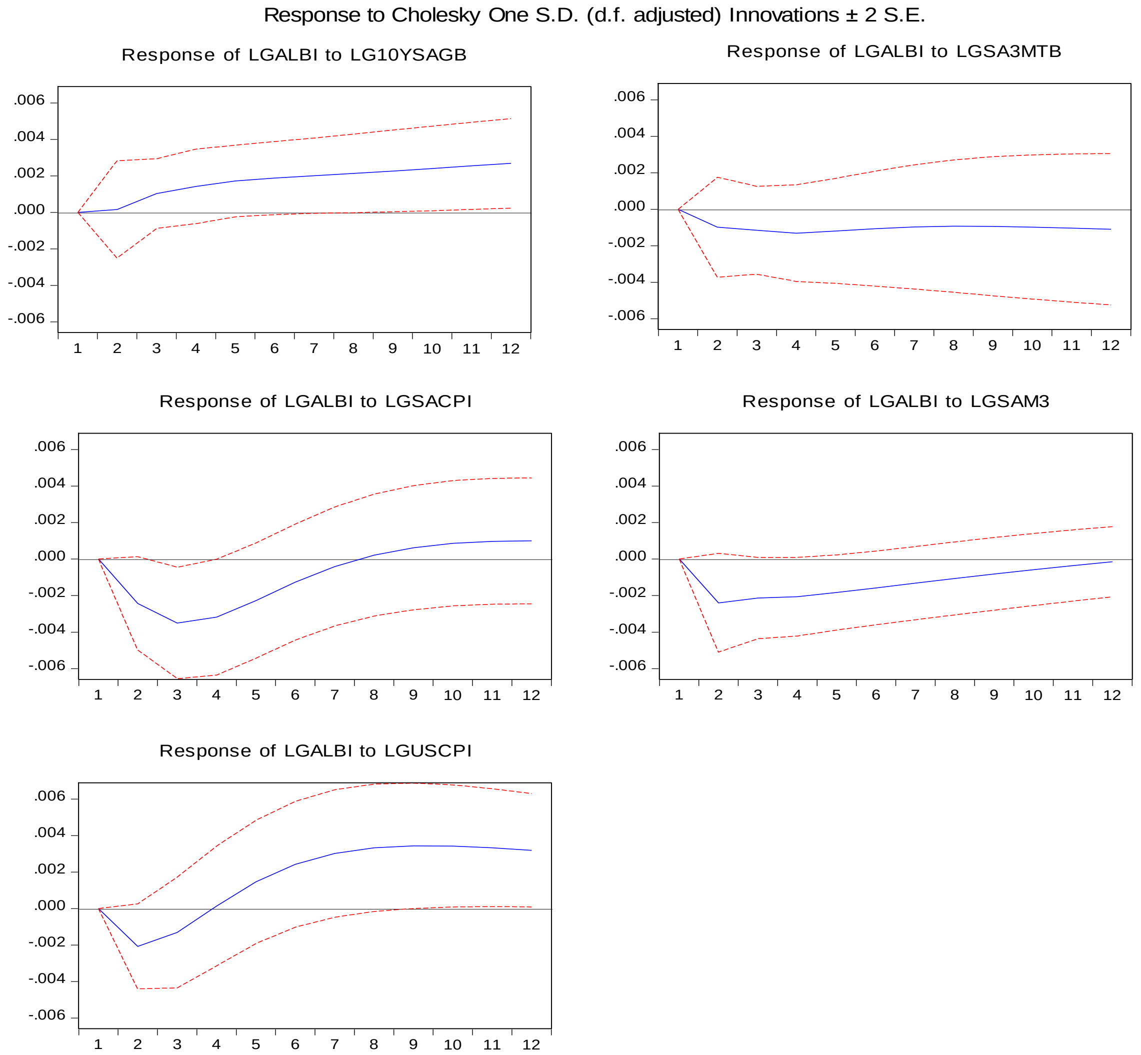
The reversion force is significant in all indices in this study. The speed of reversion in the next month is greatest for DJIA with 0.44 and slow with ALBI with 0.04. The speed of adjustments indicates how fast the respective indices respond to changes in economic fundamentals, moreover, this helps investors better forecasts for long-term security prices.

Moolman, Bank, and Du Toit (2005) verified these findings while creating a structural, theoretically based model of the South African stock market that was estimated using cointegration and error correction techniques. The findings indicated that share prices and the factors stipulated by the anticipated present value model of asset price determination are cointegrated. The studies also claim that macroeconomic variables such as interest rates, risk premium, exchange rates, foreign stock markets, inflation, and other variables impact short-term asset price swings. According to Moolman et al. (2005), the presence of cointegration also explains the size of each variable's impact on the stock market index's long-term level. Furthermore, an ECM nicely captured the short-run stock market dynamics (Moolman, Bank, and Du Toit, 2005)

4.3 Impulse Response Function tests results

The focus of the research thus far has been on developing a long-run equilibrium relationship and error correction between stock market index levels and macroeconomic variables. The interplay between macroeconomic variables and stock market prices in the short run is the subject of this section. On LG10YGB, LGSA3MTB, LGSACPI, LGUSCIP, and LGSAM3, the Impulse Response functions trace the response of the All-Bond Index to a one-time positive standard deviation.

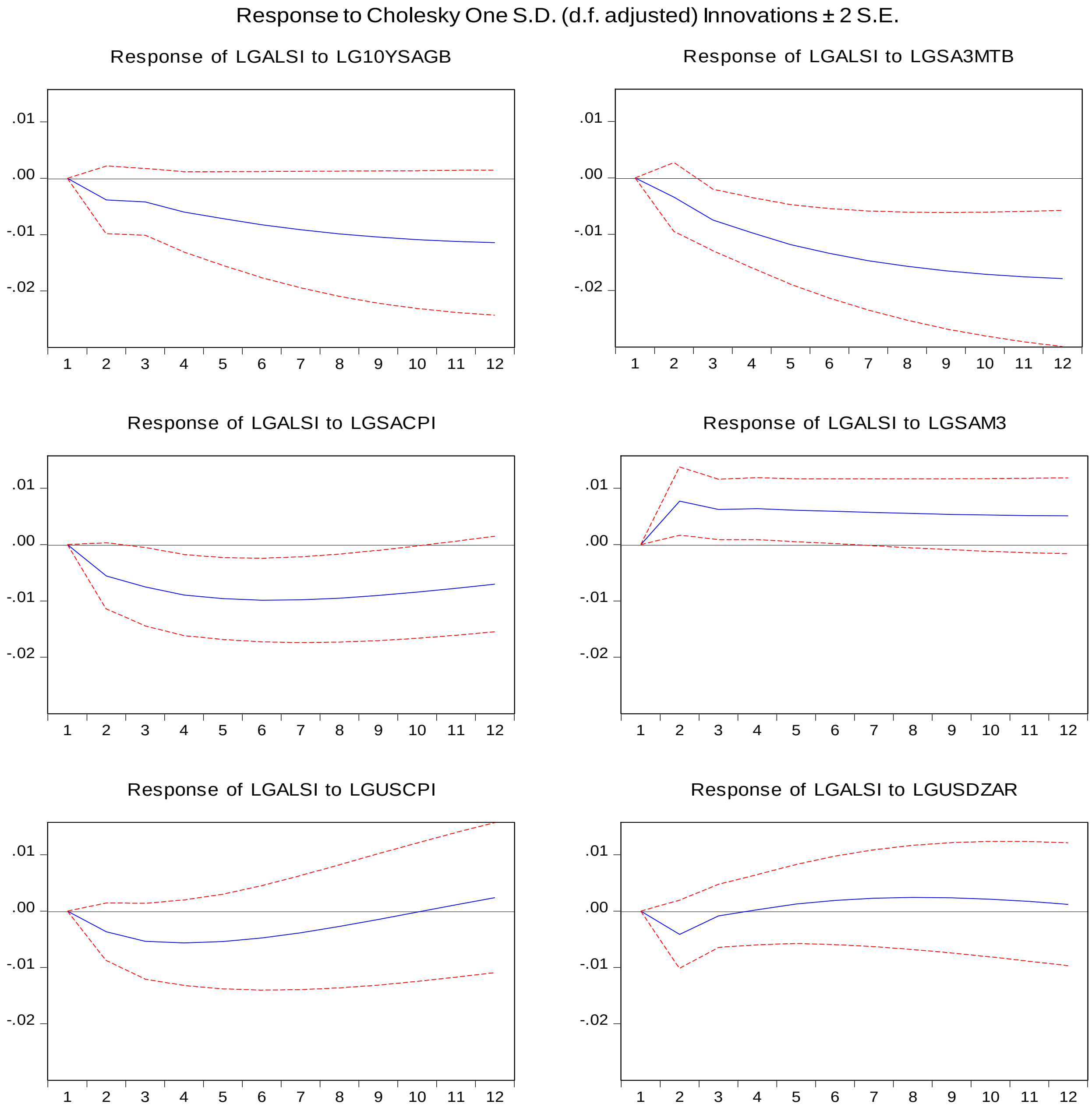
Figure 7. All Bond Index



Regarding figure 5, LGALBI responds positively to one standard deviation shock. On LG10YGB, the response is more pronounced during the first 3 months of the shock while during the last 9 months, the ALBI level seems to be rather stable. This is largely because long-term interest rates are determined by market forces of bond demand and supply. An opposite response due to short terms shock is noticed. This is because short-term rates are fundamentally inversely related to bond prices. Also, the bond index level dives during the first 3 months of the interest rate shock.

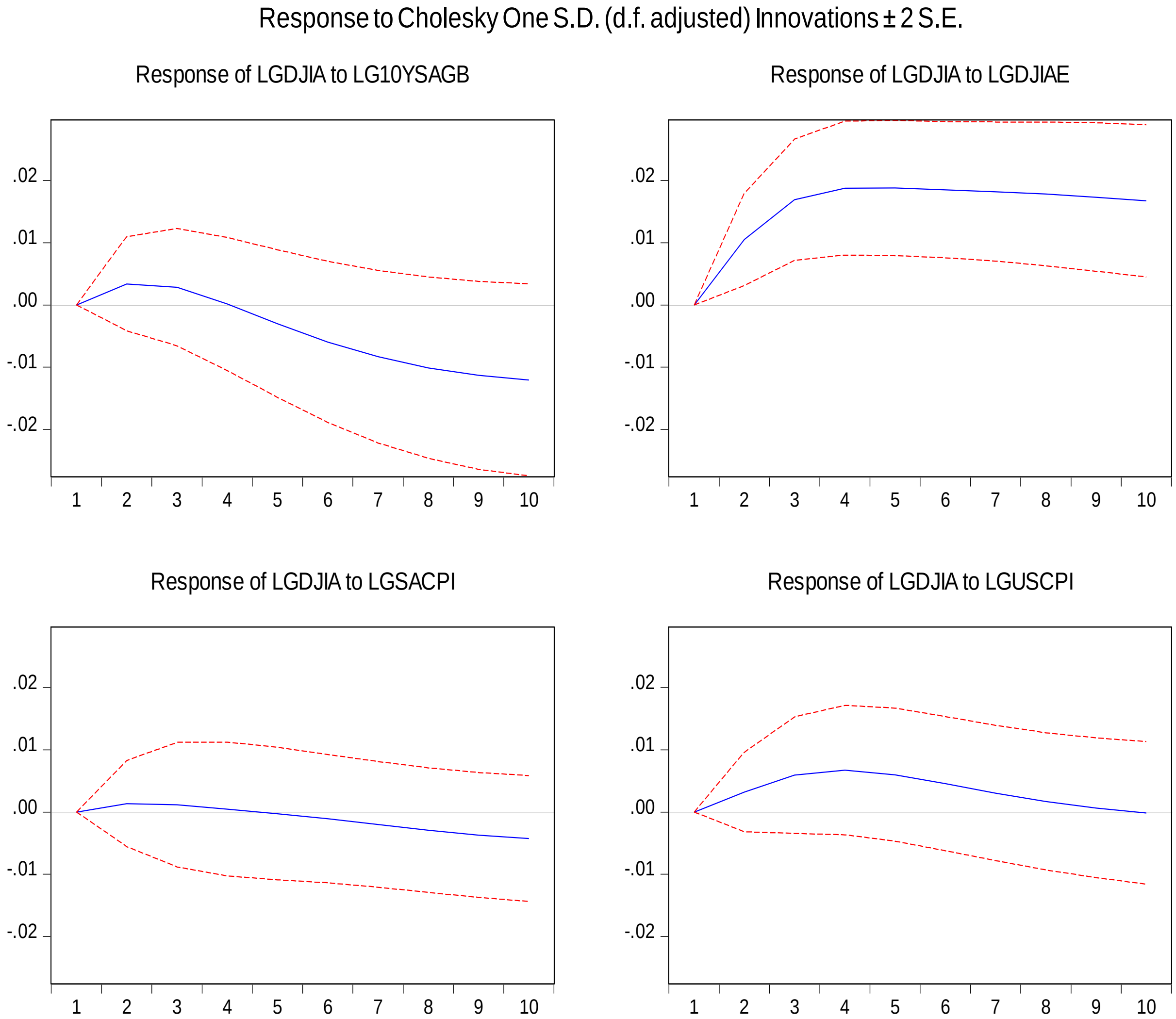
All bond index responds negatively for the first 3 months to one-time standard deviation shock on LGSACPI and LGSAM3, beyond the quarter the bond level gentle increase. This means bonds and money supply tend to have a positive relationship, in the long run, that is past 12 months. The same reaction is also noticed with LGUSCPI.

Figure 8. All Share Index



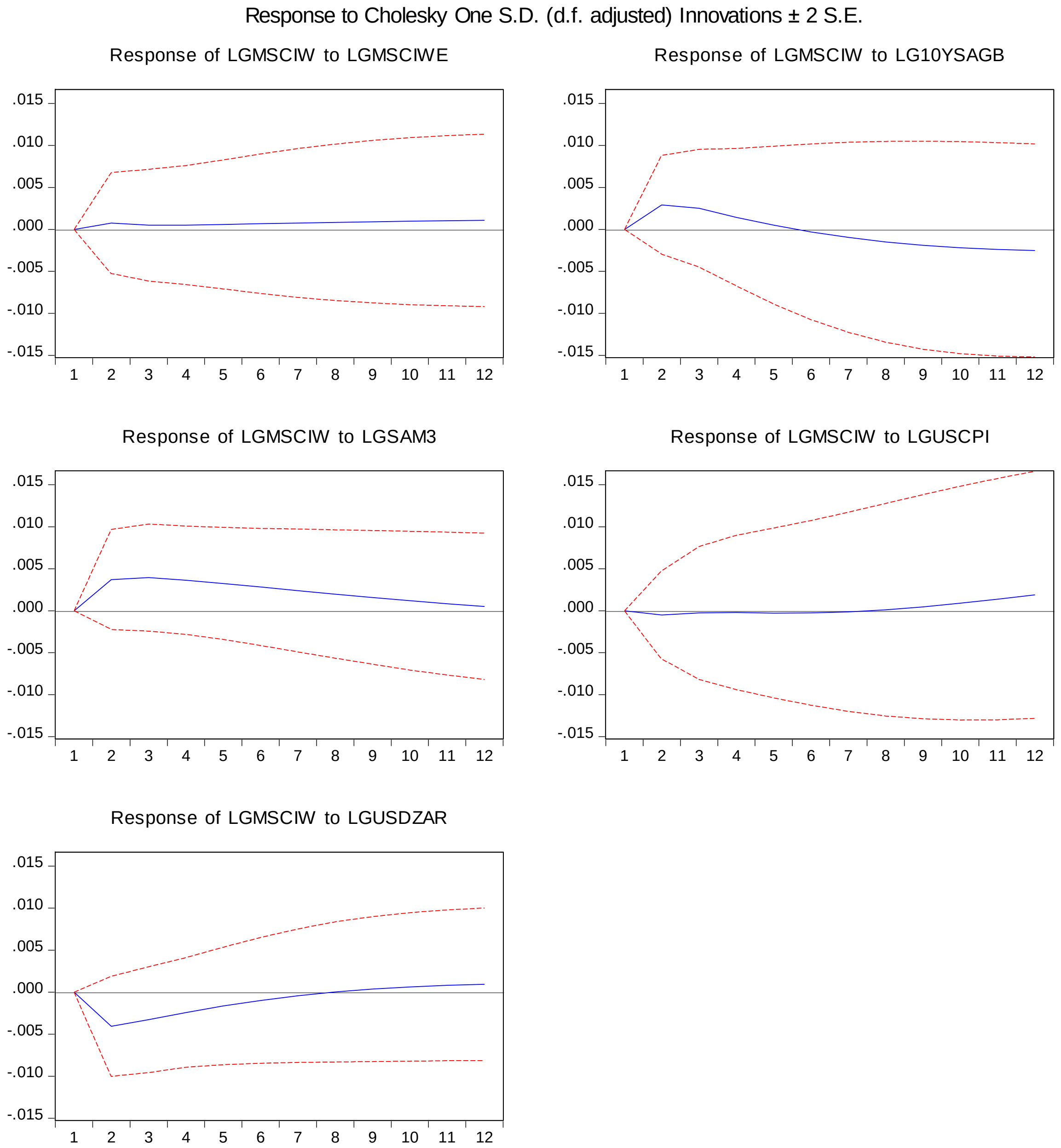
Regarding figure 6, the LGALSI reacts negatively to the long-term and short-term interest rates with one standard deviation shock. The negative relationship stabilizes showing signs of a slightly positive reaction in the long run. The stock market reaction to short-term rate change is more than the reaction to long-term rates. This is because a slight increase in interest rates will increase discount rates and limit liquidity in the market which results in a decline in share valuations. The shock on LGSACPI, LGUSCPI, and LGUSDZAR resulted in a decline in index level, with a reaction to LGUSCPI and Money Supply changing to a positive index level in the long run. This explains why investors should hedge using ALSI if the US inflation is relatively high. Reaction to LGSACPI remains negative for the next 12 months. Money supply has a huge positive shock on ALSI largely because of excess liquidity in the market.

Figure 9. Dow Jones Industrial Average



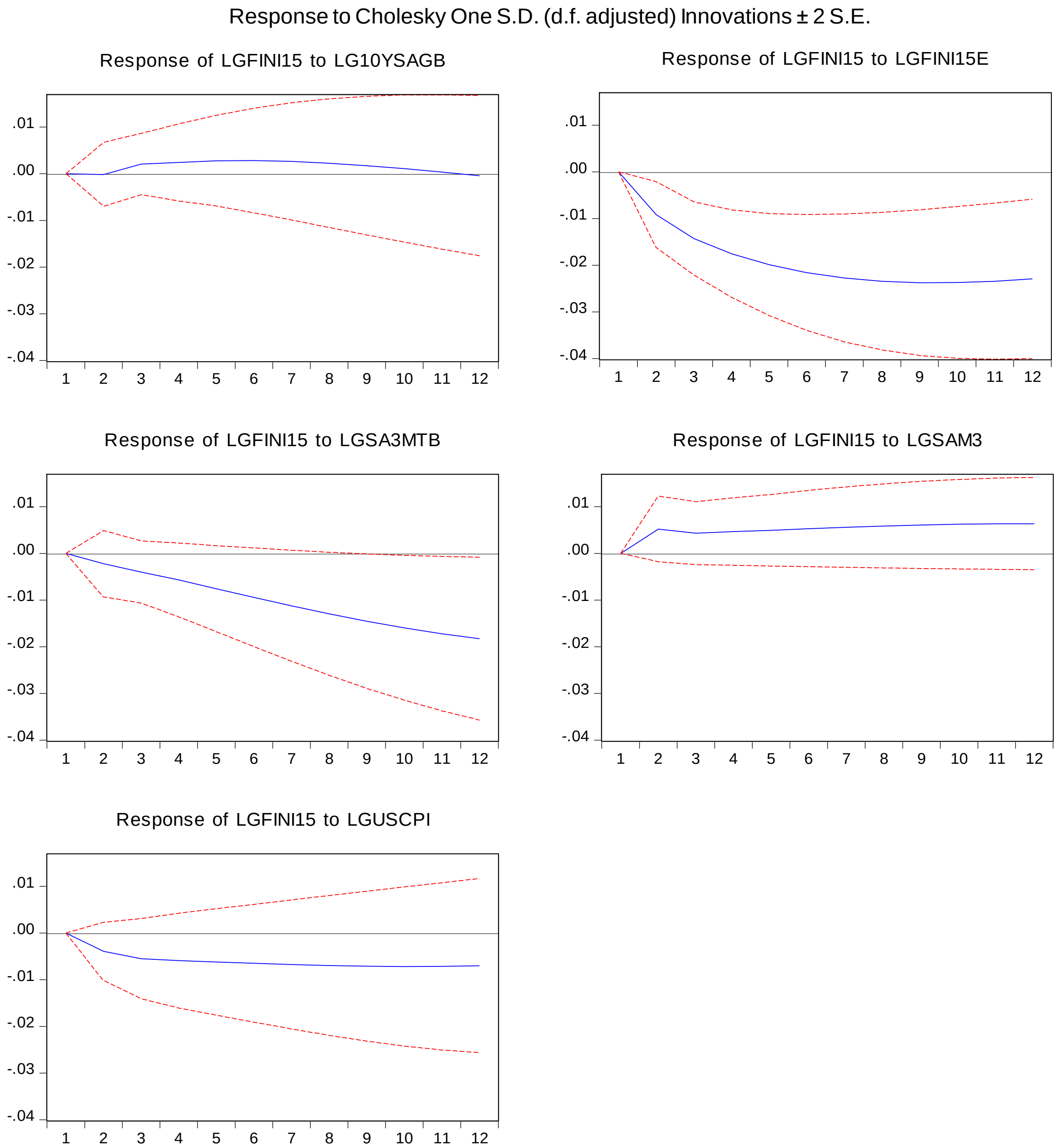
LGDJIA reacts with a strong positive swing due to the one positive standard deviation shock on its earnings. A strong positive is noticed within the first 4 months after the shock. Beyond 4 months, the index level becomes stable going forward. LGDJIA level has a minimal reaction to SACPI shock, although the relationship is negative in the long term. DJIA Index level has a significant positive reaction for the first 3 months to a shock on LG10YSAGB and LGUSCPI. Little reaction to SACPI by DJIA is because few DJIA constituents have their main operations in South Africa hence little influence comes from SA inflation.

Figure 10. MSCIW



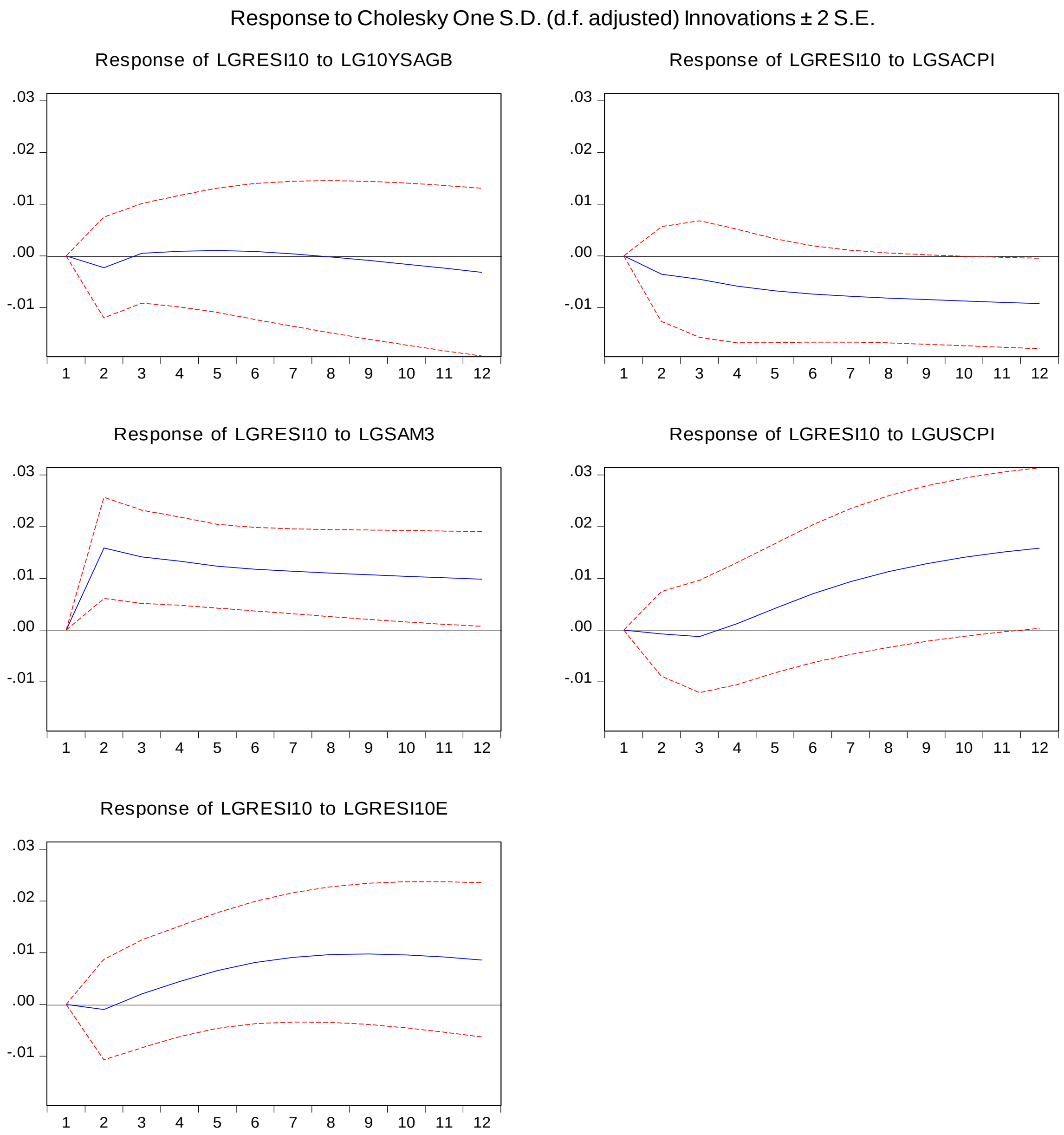
In figure 10, MSCIW has little reaction to shock in LGUCPI and its earnings for the first 12 months, the relationship however comes out as positive. LGMSCIW has a strong positive reaction due to the long-term and short-term interest rates for the first 3 months, the reaction becomes negative from the 4th month going forward. This is because interest rates increase discounting factors and tighten liquidity which in turn has a negative impact on share price valuations. The reaction is positive due to the shock on exchange rates.

Figure 11. FINI15



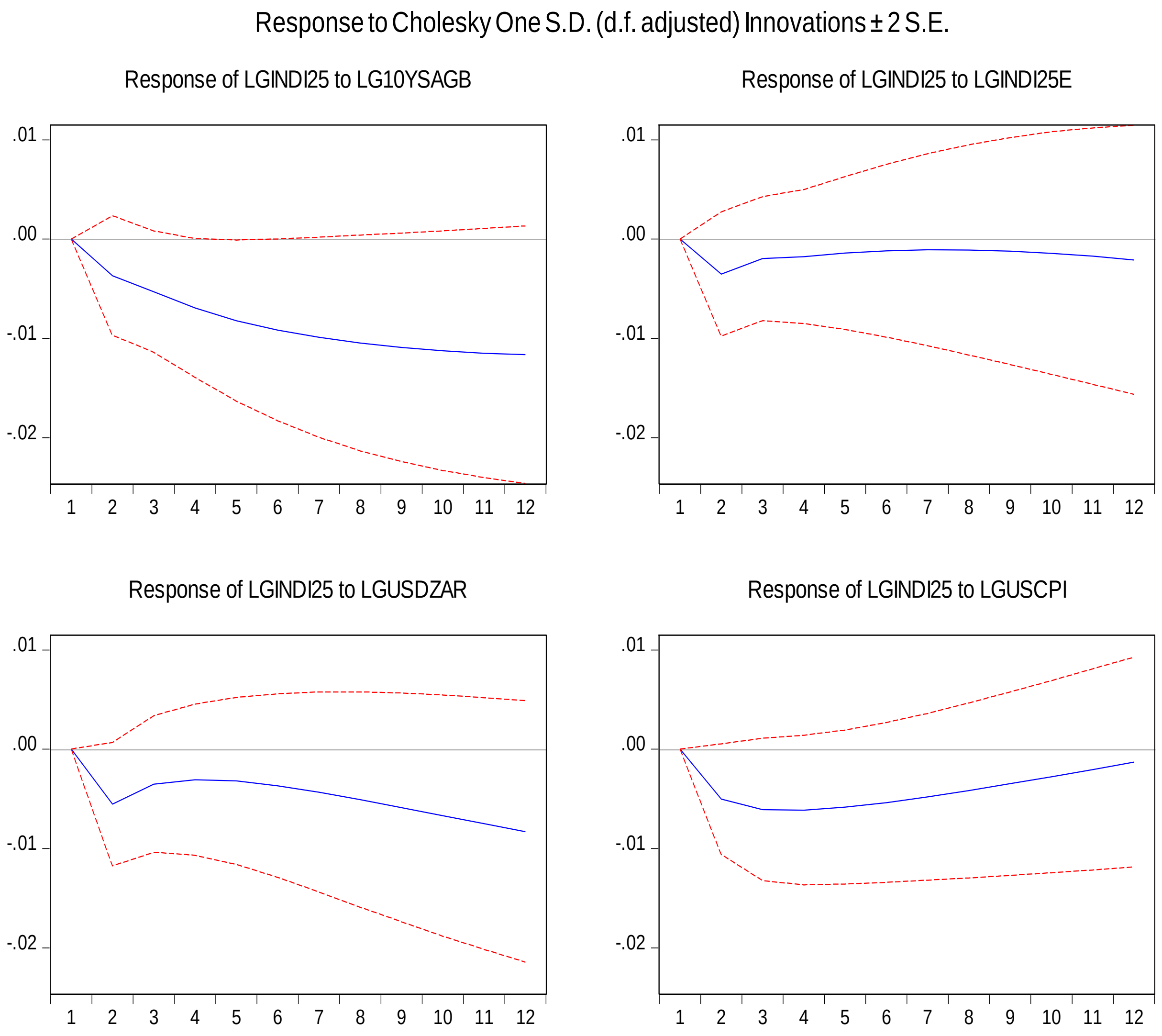
According to figure 11, LGFINI15 has a strong negative reaction to shocks on the short-term rates in the short run due to its positive influence on the discounting factor. A similar reaction is observed with long-term interest rates although gravitating towards negative in the long term and US inflation shocks although the positive reaction is more prominent in the long run, that is post 12 months. FINI15 reacts negatively to the shock on its earnings in the short run, this reaction seems to stabilize in the long run, which will eventually become positive. This cements the positive relationship between earnings and FINI15. FINI15 reacts positively to SA money supply during the first 3 months and the relationship becomes constant in the long run.

Figure 12. RESI10



RESI10 has a little negative reaction to a long-term interest rate shock over 12 months from the shock period. Interest rate shock has a negative influence on the share price and the share price level changes in the short term. Money supply, US Inflation, and RESI10 earnings shock all resulted in a positive reaction by RESI10 over 12 months. SA inflation shock causes a negative reaction by RESI10 over the 12 months, mainly because in the short run inflation results in inflated costs to businesses and causes a decline in share prices.

Figure 13. INDI25



INDI25 reacts negatively due to the shocks in long-term interest rates and exchange rates in the short run. This is because some of the INDI25 constituents have operations abroad and are hugely affected by exchange rate fluctuations. The index reacts negatively during the first 2 months of earnings shocks and then changes to a positive reaction after 3 months, according to (Miller and Modigliani, 1961) dividends are paid from earnings and if there is an increase in index earnings the anticipated future dividends will increase which has a positive effect on the index level. US inflation one standard deviation shock result in negative reaction during the first 2 months the goes on positive trajectory after 3 months going forward. This is because relatively high inflation in the US will cause investors to rebalance their portfolios, some will significantly increase their investments in the emerging markets or even look for alternative asset classes in JSE.

4.4 Variance Decomposition

Table 14. All Bond Index

Periods	S. E	LGALBI	LG10YSAGB	LGSA3MTB	LGSACPI	LGUSCPI	LGSAM3
3	0.031469	96.17038	0.108699	0.232646	1.837400	0.609963	1.040915
6	0.038273	94.15105	0.653310	0.448033	2.393024	0.961861	1.392723
9	0.041373	91.92776	1.360844	0.539165	2.083082	2.691489	1.397663
12	0.043130	89.40703	2.299539	0.669226	2.061239	4.251114	1.311850

After measuring the reaction of the stock market index due to shock in macroeconomic variables in the short run using Impulse Response Function, it is important to further unpack what proportion of each macroeconomic variable explains the share price movements in the short run. To do this, variance decomposition was estimated. The variance decomposition estimation explains the power each macroeconomic variable has in explaining asset price level.

In Table 14, it can be stated that for 12 months, subdivided quarterly, All Bond index level has a dynamic relationship with the economic variables. However, a greater part of the index level is explained by its volatility, for example in the 3rd month 96% of the index level is explained by itself. It is interesting to note that among macroeconomic variables US Inflation has a huge impact on the SA Bonds price level explaining about 4.25% of the index in month 12. This could mean that the index level is better explained by other variables not included in this study, mostly its past performance. According to Lamba & Otchere, (2001) most of the Forecast Error Variance of a series is explained by its volatility and that past performance better explains future Index level movement.

Table 15. All Share Index

Periods	S.E	LGALSI	LG10YSAGB	LGSA3MTB	LGSACPI	LGUSCPI	LGSAM3
3	0.073533	95.46719	0.687418	1.101112	1.354588	0.639155	0.750536
6	0.098736	89.13540	2.223891	4.340698	3.066033	0.795180	0.438797
9	0.116773	83.06181	3.910659	8.239474	3.843045	0.616256	0.328752
12	0.130599	77.59707	5.430641	12.13775	3.984727	0.583655	0.266158

All share index level is better explained by their volatility, with 95% of its level on the forecasted 3 months explained by its movement or other variables not included in this study. It must be noted, however, that in the long run, the proportion of index level explained by itself decreases. Short-term rates seem to explain about 12.13% of the index level during the 12th month of the short-term interactions, followed by long-term interest rates which explain 5.43% of the All-share Index level in the short run.

Table 16. Dow Jones Industrial Average

Periods	S. E	LGDJIA	LGDJIAE	LG10YSAGB	LGSACPI	LGSAM3
3	0.075300	92.12082	7.271003	0.507516	0.044390	0.056274
6	0.098373	83.71112	15.41783	0.583399	0.240484	0.047174
9	0.112571	78.88671	18.47951	2.057786	0.523822	0.052171
12	0.122463	75.19694	19.97587	4.060503	0.673697	0.092988

The forecast error variance indicates that in the table above, the DJIA index level is better explained by its volatility during the 12-month short run period. During the 12th month, 75% of the index level is explained by the DJIA movement followed by its earnings which explain close to 20% of its price level. Long-term SA interest rates explain 4% of the index level above with SACPI and SA money supply only explaining 0.67% and 0.09% respectively on the forecasted 12th month. The reason why there is little influence by other variables it's because most of the DJIA constituents do not have operations in South Africa hence not so much affected by its macroeconomic variables.

Table 17. MSCIW

Periods	S. E	LGMSCIW	LGMSCIWE	LG10YSAGB	LGSAM3	LGUSCPI	LGUSDZAR
3	0.083384	98.95515	0.011605	0.213320	0.422342	0.004818	0.392765
6	0.112734	99.07604	0.014634	0.135486	0.480124	0.004132	0.289585
9	0.129991	99.17726	0.023550	0.141582	0.433341	0.004610	0.219657
12	0.141651	99.15397	0.035540	0.203459	0.376920	0.035578	0.194531

The MSCIW index level as confirmed by empirical evidence, explains the greater proportion of its level through the short-term period. 99% of forecast error variance is explained by MSCIW index level fluctuations and or historical data. SA money supply, long-term interest rates, and USDZAR only explain 0.37, 0.20, and 0.19%, respectively. This shows that the index level is better explained by other factors not included in this study. This could be US macroeconomic variables among others.

Table 18. FINI15

Periods	S. E	LGFINI15	LG10YSAGB	LGFINI15E	LGSA3MTB	LGSAM3	LGUSCPI
3	0.089859	95.00472	0.054016	3.547447	0.258785	0.572007	0.563029
6	0.128351	88.11354	0.158351	8.812562	1.206898	0.734131	0.974518
9	0.157092	82.37131	0.167462	12.47009	2.848545	0.909884	1.232709
12	0.178598	77.61637	0.134323	14.77003	4.972426	1.080777	1.426076

In the table above, the explanatory power of FINI15 on its level is getting weaker over time. In the 12th month, FINI15 explains 77.6% of its index level with its earnings showing a strong explanatory power over time explaining 14.7% of FINI15 index level followed by short-term interest rates which explain 5% of the index level in the 12th month.

Table 19. RESI10

Periods	S. E	LGRESI10	LG10YSAGB	LGRESI10E	LGSACPI	LGSAM3	LGUSCPI
3	0.114999	96.23108	0.040911	0.034941	0.251656	3.427125	0.014285
6	0.140773	93.43444	0.040497	0.493863	0.914322	4.718216	0.398661
9	0.156796	89.75996	0.036493	1.212061	1.647706	5.357379	1.986397
12	0.169039	85.96000	0.095709	1.650033	2.355730	5.739857	4.198673

Regarding table 19 above, the variables with strong explanatory power to the RESI10 index level are SA money supply, US inflation, and SA Inflation with 5.7, 4.2, and 2.35% respectively. Only 1.65% of the RESI10 index level is explained by its earnings in the 12th month. As stated earlier that a greater proportion of the index level is explained by its fluctuations, in this case during the last month of the short run period 85.9% was the explanatory power of the RESI10 index by its movement. The explanatory power becomes weak over time.

Table 20. INDI25

Periods	S. E	LGINDI25	LG10YSAGB	LGINDI25E	LGUSCPI	LGUSDZAR
3	0.079319	97.40928	0.660199	0.259515	0.509124	1.161882
6	0.107467	95.64882	2.087734	0.197618	0.806422	1.259405
9	0.127850	94.09968	3.474522	0.162946	0.684912	1.577939
12	0.144425	92.56188	4.613547	0.172582	0.546742	2.105248

In table 20, a greater portion of the index level, about 92.6% is explained by its fluctuations. These could be other factors not considered in this study. Long-term interest rates, exchange rates, US inflation, and INDI25 earnings have 4.6, 2.1, 0.55, and 0.17% explanatory power, respectively. Long term interest rate is gaining explanatory power over the period from 0.66% in the 3rd month to 4.6% during the last month of the short-term period. The results are consistent with the findings of Chinzara, (2011) on the same subject.

4.5 Overview of the results

The goal of the study was to see if there was a long-term relationship between the stock market and macroeconomic variables, as well as to better understand the explanatory power of each macroeconomic component coupled with the magnitude of impact on stock market index levels. Between macroeconomic indicators and stock market index levels, there is a long-term relationship. Furthermore, the stock market index level may depart from the long-run market equilibrium and, through ECM, readjusts to the long-run equilibrium. Historical index levels can be used to estimate the speed of adjustment for index levels to revert to long-run equilibrium. These results are consistent with the findings obtained by Campbell Robert and Campbell Robert J Shiller, 1988; Southern Africa, Jefferis, and Okeahalam, 2010; Majid, (2016).

In line with Harasty and Roulet's (2000) findings, the share prices deviate from the long-run market equilibrium, the deviation happens in the short term largely due to the investor sentiments and other financial variables other than economic variables. Share prices are mostly not fairly valued in the short term, this is consistent with study findings which indicate deviation from the mean in short term. In long term, however, investors realize the widening gap between the market and fundaments and respond by either buying or selling securities.

In the short run, macroeconomic variables do not show a strong explanatory power on the stock market index levels. Variance decomposition proved that during the forecasted 12 months period stock market index levels are explained by themselves. This means the macro variables in the models have little explanatory power. Lamba and Otchere, (2001) further assert that stock market volatility is better explained by its volatility and that historical index levels better forecast future stock market index movement. The lack of explanatory power by macroeconomic variables can be attributed to the level of diversification of listed companies to the international stock markets. Samouilhan and Shannon, (2008) estimate that interdependence and contagion amongst markets further increase the correlation between asset prices and volatility between securities exchanges.

4.5.1 Inflation

This study has established a long-term positive relationship between inflation and stock market index levels. Contrary to many research findings which concluded that there is a negative relationship between inflation and stock market index levels, Fama and Schwert, (1977 and Geske, Chen, and Roll, (1983) stipulate that there is a negative relationship between inflation and stock market index levels.

A positive long-term relationship between inflation and asset prices, however, is not impossible. Positive changes in inflation directly increase stock prices. This happens through inflating anticipated future company cashflows and economic growth through inflation. Nominal interest rates may increase with inflation in a bid to control increasing inflation, as a result, the anticipated negative influence of increased interest rates and positive effects of the expected increase in future cashflows cancel each other. Irvin Fisher (1930) concluded that the expected rate of return consists of real return and expected rate of inflation meaning when discounting for future cash flow, inflation has already been considered which renders the relationship positive.

Goswami & Jung, (1997) states that in developing markets, a stable and low inflation rate stimulates economic growth in real activity which allows positive effects on stock market prices. Before the introduction of inflation targeting monetary policy in 1999, South Africa’s economic landscape was characterized by high inflation levels. The introduction of inflation-targeting monetary policy has been successful in maintaining stable and low inflation. This same study found a significant positive relationship between short-term interest rates and share prices. This goes on to confirm through the transmission mechanism that the positive relationship between inflation and share prices is not far removed. These results were also confirmed by Bodie, (1976) who concluded that equities are hedged to inflation as shares claim on real underlying assets.

4.5.2 Interest rates

The research looked at both short and long-term interest rates. The model concluded that short-term interest rates and share prices have a positive long-term association, whereas long-term interest rates and index levels have a negative long-term relationship. In a present value model of stock prices, the predicted future short-term interest rates are used to discount future returns, hence the long-term rate can be utilized as a discounting factor because it captures the expected short-term interest rates (Harasty and Roulet, 2000). The market determines long-term interest rates. To compensate for the uncertainty about predicted security prices, they apply a risk premium to the discount rate (Moolman, Bank, and Du Toit, 2005).

The long-term interest rates used as a discounting factor support the negative relationship with the share prices. An increase in interest rates will result in an increase in discounting factor used on asset valuation hence the negative relationship. The results are consistent with the findings of Alam, Gazi, and Uddin, (2009) who reported a negative relationship between South African stock market prices and interest rates.

Changes in interest rates tend to coincide with business cycle dynamics and other economic variables. It is therefore not always clear what is attributable to the changes in interest rates and also what is attributable to other economic variables (Ehrmann and Fratzscher, 2004).

4.5.3 Money Supply

This study found that there is a long-run co-movement between stock prices and money supply. It must be noted however that a significant positive long-run relationship was established with the JSE stock market index while a negative relationship existed between DJIA and MSCIW with the South African money supply. The negative relationship between money supply and stock prices are based on the short-term liquidity effect. The liquidity effect asserts that a money supply increase creates an excess supply of money at current levels of income, interest rates, and prices.

Money demand is a diminishing function of nominal interest rates, and storing cash has an opportunity cost. Central banks regulate money supply through open market activities, bond buying and selling, and interest rate adjustments. To boost the money supply, central banks will lower short-term interest rates, causing bond prices to rise and the central bank to infuse funds into the economy through long bond purchases. As a result, as the money supply grows, interest rates fall to maintain the money market's balance (Choi and Yoon, 2015). This transmission mechanism, on the other hand, is only viable if the money demand curve changes to the left or does not shift at all when the money supply increases.

If an increase in money supply is coupled with an increase in money demand, then the new equilibrium interest rate might be higher than the old equilibrium rate. This is likely to happen in markets experiencing higher output due to expansionary monetary policy. In essence, a negative relationship established in this study between South African money supply and DJIA & MSCIW is possible, especially in an expansionary monetary policy.

The positive relationship found between South African stock market index levels and money supply is consistent with financial theory. The increase in the supply of money has an expansionary effect on the economy, it boosts corporate earnings and increases liquidity in the economy (Mukherjee and Naka, 1995). If money increases more, and interest rates decrease, there is an indirect downward pressure on the discount rate which increases expected future corporate cash flows.

4.5.4 Earnings

A cointegrating relationship exists between stock market index earnings and stock market index levels. A significant cointegrating positive relationship was observed in the study. Miller and Modigliani (year) assert that there is a positive relationship between earnings and stock market prices. This is because when we look at the Dividend Discount Model, the numerator (Dividends) is paid from company earnings. If investors anticipate an increase in company earnings, then intuitively, anticipated future dividends will increase as a result share prices will be projected to increase (Gordon, 1959).

4.5.5 Exchange rates

The study established a significant positive relationship between share price and exchange rates. This means that a long-run dynamic relationship exists. The relationship could be due to a traditional approach which states that currency depreciation increases exports and in the process exports company earnings increase and ultimately driving the share price up (Kutty, 2010). Kutty, (2010) further asserts that there is a portfolio adjustment approach that states that foreign capital inflows and outflows of a stock exchange are determined by the momentum that is if stocks prices are increasing in South Africa, they attract more capital inflows and, in the process, the ZAR appreciates.

These results are in line with the findings of Jefferis and Okeahalam, (2000) on the JSE equity returns and USDZAR exchange rate, where they concluded that there is a positive long-term relationship. Adjasi & Biekpe (2006) further confirmed the results by investigating seven African countries using cointegration analysis and found that there is, in the long run, exchange rate depreciation leads to an increase in the stock market returns.

Chapter 5

5.1 Conclusions and Recommendations

The two-step ECM by Granger enables us to identify cointegrating relationships between stock markets and economic fundamentals at the index level. The results prove the theoretical interrelation that exists between the market and its macroeconomic fundamentals. Granger (1986) alludes to the ability of an economic theory to adequately capture the long-term market equilibrium, in the short term, however, economic shocks may push index levels away from their market equilibrium.

The concepts of long run fair value and short run deviations formalise the intuitive vision investors have of the functioning of financial markets. The long run regressions confirm the correlations between the stock market and the economic fundamentals that many investors have in mind and quantifies this relation. The concept further provides investors with an order of magnitude for present and previous valuations gap and how long they have lasted.

The study sought to establish a long-term relationship between index levels and preselected macroeconomic variables using monthly data from January 2001 to January 2021. The study concluded that there is a cointegrating relationship between ALBI, ALSI, FINI15, RESI15, INDI25, MSCIW, and DJIA and preselected macroeconomic variables. The relationship between the variables is contemporaneous with most macroeconomic variables having a significant impact on each other for example short-term rates, inflation, and money supply. The research made use of the security valuation model and proved above all else that factors influencing discount rate, anticipated cashflows (Expected Dividends), and required rate of return determine the movement of index levels both in the short run and long run.

The study used cointegration to test the long-run relationship between index levels and macroeconomic variables, existence of cointegration reflected the magnitude of the impact of each variable on the long-term index level which was found to be significant at a 95% confidence level. ECM was estimated to capture the short-term fluctuations of a stock market index, stock market index level deviates from the long-run equilibrium, however time in the short-term period, share prices revert to the equilibrium. The study proved the concept of mean reversion. The study further captured the influence of macro variables in the short term using IRP and Variance Decomposition, this was to ensure that the study robustness.

The IRP captured the reaction of index levels due to one standard deviation shock on the economic variables, the conclusion is that the explanatory power for macroeconomic variables becomes stronger over a long period, something worth noting, however, is that there are other non-economic variables not included in this study that influence index levels, for example, geopolitical events and trading updates announcements. Variance Decomposition proved that the greater part of index levels' volatility was due to its volatility and macroeconomic variables gained strong explanatory power over time. This conclusion further proves that the index level fluctuations can be explained by their historical fluctuations.

5.2 Limitations

Making use of longer-term and more frequent data improves the accuracy of results when estimating cointegration and error correction models for economic and financial variables. Getting long-term and more frequent data for GDP and BOP was a challenge hence the study did not consider these fundamental economic variables. Furthermore, some major FTSE/JSE indices have data starting from 2001 to date, FINI15, ALBI, RESI10, and INDI25 index levels data record starts from 2001 to date and this limits data set length. The models were going to produce more accurate results if the data set was longer than 20 years.

5.3 Recommendations for further research

Based on the above findings, it will be interesting to investigate the impact of global economic variables on JSE index fluctuations over a much longer period as markets are becoming more integrated. Future research may consider evaluating qualitative variables and share price long-term relationship, this might answer the question of investor sentiments impact on mean reversion. It will also be interesting to see asset class allocation under different economic conditions and the existence of a comparative long-term relationship between share performance and different investment styles for example value, momentum, and growth investment styles. With this said, a hypothetical portfolio may be created and a structural model similar to this study implemented to ascertain the level of accuracy using empirical data.

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