Macroeconomics and Monetary Economics

Macroeconomic Variables, Leverage, Stock Returns and Stock Return Volatility

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Abstract: This paper investigates the relationship between the macroeconomic variables, leverage and the stock returns on the Johannesburg Stock Exchange using ARDL bounds testing approach and Vector error correction model. A further analysis on the effects of leverage on volatility was done using a generalized autoregressive conditional heteroscedasticity (GARCH 1,1) method. The study revealed that there is co-integrating relationship between macroeconomic variables and stock returns. Particularly, there is a long run relationship between stock returns and real GDP, and also between stock returns and interest rates. Additionally, this paper shows that leverage affects the volatility of stock prices. Finally, it is noted that after disequilibrium the economic model will always adjust to equilibrium at a rate of thirty-three percent within a year. Since leverage positively influence volatility in stock returns investors that are risk averse should avoid highly geared firms.

Keywords: Stock returns; volatility; leverage; Co-integration; Macroeconomic variables

1. Background

High government debt, sovereign rating downgrades, low economic growth, energy problems and the worst recorded drought since 1904 are some of the challenges that South Africa is facing. The rand tumbled to 16.05 against the US dollar in December 2015 due to policy uncertainties which were triggered by the reshuffling in the finance ministry and the rand fell by 9.6 percent against the US dollar (South Africa Reserve Bank (SARB), 2015 CNBC, 2016). According to Moody (2015) the fiscal debt of South Africa is at 45 percent of gross domestic product (GDP) with low business confidence which has seen a decline of credit extended to the domestic private sector. The SARB Quarterly Bulletin (March, 2016) has officially identified November 2013 as the tipping point of the South African economy being in the

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downward phase of the business cycle. Fama (1991) posit that the behaviour of stock returns is related to the real economy. This assertion was further supported by (Lu, Metin & Argac, 2001; Kirui, Wawire, & Onono, 2014) when it was stated that the stock market returns are determined by macroeconomic fundamentals. Domestic financial systems that are more leveraged with rapid credit growth tend to suffer larger downward risks of stock returns (Berkmen, Gelos, Rennhack & Walsh, 2009). Stock returns in most emerging markets exhibits volatility clustering and leverage effects (Appiah-Kusi & Menyah, 2003; Alagidede, 2011). The stock returns should fully reflect the available information (Fama, 1965; Fama, 1970). According to Chinzara (2012) the South African domestic financial market is increasingly becoming interdependent with the global economy, increasing the macroeconomic uncertainties and the volatility of the stock returns.

The weakening of growth in China and the subsequent sell-offs in the Chinese stock market has exacerbated volatility of the global markets. (South Africa Reserve Bank, 2015). According to Kirui et al., (2014) stock returns are determined by macroeconomic variables such as interest rate, inflation, exchange rate, liquidity and gross domestic product among others. Together with banks, stock market provides a channel for financial intermediation with the stock market as the main conduit of long term financing (Levine & Zervos, 1995; Khambata, 2000). Using Box-Jenkins ARIMA model for Brazil, Russia, India and China (BRIC), Gay (2011) stated that there was no relationship between the macroeconomic variables and stock returns. This was in contrast with Coleman and Tettey (2008), who examined the impact of macroeconomic variables on Ghana Stock Exchange and found a significant relationship between macroeconomic variables and stock returns. Elly and Orio (2012) concurred that macroeconomic fundamentals has a significant impact of stock returns in Kenya.

Evidence from (Gay, 2011; Coleman & Tettey, 2008; Elly & Orio, 2012) has different conclusions on the effect on macroeconomic variables on stock returns. The differences are in different countries and across different methodologies, hence the main purpose of this study is to determine and evaluate the macroeconomic shocks that can result in changes in the stock returns of listed companies on the Johannesburg Stock Exchange (JSE). We examined the short run and long run relationship using the autoregressive distributed-lags (ARDL)-Bound testing approach and the vector error correction model (VECM). Results shows that there is significant cointegrating relationship between stock returns and interest rates as well as real GDP. The generalised autoregressive conditional heteroscedasticity (GARCH) model was used to determine the effects of the macroeconomic variables on the volatility of stock return and results indicates that leverage significantly influence stock market price volatility.

Since the reviewed literature show that the macroeconomic variables affect the stock returns at varying magnitudes and significance, the study will help investors and

policy makers to be informed of the macroeconomic variables that has an effect on the asset prices for risk return trade-offs of for their investment choices. For policy makers the information will be important to identify variables that can trigger economic recession

The paper is organized as follows: Section 2 reviews the literature Section 3 discusses the data and the empirical methodology. The empirical analysis and results are presented in section 4. Finally, Section 5 concludes the study.

2. Literature Review

The stock market in most developed financial markets responds to changes in the macroeconomic fundamentals. Financial liberalisation and globalisation has led to the increase of funds by international investors in the emerging markets to take advantage of the benefits of diversification and increased liquidity (Abugri, 2008; Stefanescu & Dumitriu, 2013). Globalisation and integration of the financial market has led to investment interest in the emerging market and the interest in studying the linkages between macroeconomic variables and stock returns (Tunah 2010). Economic theory and researchers postulated that the behaviour of stock returns can be determined by macroeconomic variables. The Arbitrage Pricing Theory (APT) by Ross (1976) provided a link between the macroeconomic variables and stock returns. In the APT the return on assets is theorised as a linear function of various macroeconomic variables where sensitivity to the factor changes is given by the beta coefficient (Ross, 1976).

According to (Asgharin, Christiannse & Hou, 2015) the macroeconomic variables has a significant effect on the stock market as the uncertainty of the macroeconomic variables can result in 'flight to quality' phenomenon among investors. The information asymmetry theory of Jaffe and Stiglitz (1976) provides a theoretical idea on behaviour of economic agents in an imperfect market where economic agents with information advantage can influence prices. According to Wang (1993), under asymmetric information investors maximises their expected utility by rationally extracting information from prices and dividends. Furthermore under imperfect capital markets and information asymmetry, supply side shocks affect the risk premium and increases volatility of returns (Wang 1993). Using the GARCH model in analysing the effect of macroeconomic variables on stock returns of Romanian economy (Stefanescu & Dumitriu, 2013) concluded that the volatility of the stock returns depended on the perceptions on the performance of the national economy among others. According to Conrad, Loch and Rittler (2014) variables that contain information on current and future economic activity can be useful in forecasting changes in the stock returns.

Applying error correction model and cointegration tests in the Korean stock market Kwon and Shin (1999) found that exchange rate had a significant impact on stock prices. A study of the US economy by Sekmen (2011) postulated a negative relationship between the exchange rate and the stock as the volatility in the exchange rate increases cost of covering the exchange rate risks. The vector autoregression method used in the study of the effects of the macroeconomic variables in the Latin American countries found that the variables were significant in explaining the behaviour of stock return (Abugri, 2008). Applying the GARCH model to four different subsamples from the Romanian economy (Stefanescu & Dumitriu, 2013) found a mixed results of the exchange rate effect for the different periods under study. The effect of the exchange rate affects the stock returns and the volatility of the exchange rate can be a predictor of the returns in the stock market concluded Olugbenga (2012) in a Nigerian stock market study. However Nkoro and Uko 2013 concluded that the exchange rate had a positive insignificant influence of stocks on the Nigerian stock exchange. The effect of the exchange rate on stock market returns mainly depends on export/import orientation of the economy as the depreciation/appreciation of the currency affects the cash flow of firms (Abugri, 2008; Kirui et al., 2014). The exchange rate effect on inflation alters the investor sentiments such that depreciation in the exchange arte results in a significant negative relationship with stock returns (Bhattacharya, 2014)

There is a significant negative relationship between inflation and the stock returns through the effect of monetary growth (Fama & Schwert, 1977; Mandelkor & Tandon, 1985). Fama (1981) and Kaul (1987) hypothesised that the relationship between inflation and the stock market in negative. According to Fama (1981) the inflation and stock returns relationship is best explained by the effect of inflation to the real economy. The relationship is cyclical and depends mainly on the demand and supply factors and the real economic activity (Fama & Schwert, 1977; Fama, 1981; Geske & Roll, 1983). This contradicted the Fisher model (Fisher, 1930) and (Azar, 2010) who argued that inflation and stock returns vary in a one-to-one relationship. They further confirmed that stock returns are determined by real factors independent of inflation. Azar (2010) further argued that negative relationship between inflation and stock returns are mainly due to model specification errors as the valuation theory predicts a neutral relationship between inflation and equity prices

The theory of stagflation which explains the negative relationship between inflation and economic activity explains the transmission effect of inflation and stock returns (Fama, 1981). This was supported by Kaul (1987) when it was argued that the equilibrium process in the monetary sector causes the negative relationship between inflation and stock returns. In a multivariate decomposition study of the US data, Gallagher and Taylor (2002) confirmed a negative relationship between inflation and stock returns. This was however, contrasted by Kirui et al. (2014) in a Threshold

Generalised Autoregressive Conditional Heteroscedasticity (TGARCH) findings in Kenya where inflation had an insignificant relationship with stock returns of Nairobi Securities Exchange. Nkoro and Uko (2013) found a significant positive relationship between inflation and stock returns in Nigeria for the annual data from 1985-2009. According to Kyereboah-Coleman and Agyire-Tettey (2008) inflation has a significant negative relationship with stock returns in Ghana although its effects on stock returns took longer than other macroeconomic variables such as interest rate and exchange rate.

According to Myers (1983) in the "capital structure puzzle" the capital structure of the firms conveys a message to the investors and the corporate financing behaviour of investors affects the asset returns. Lintner (1956) and Gordon (1959) suggested that there is an optimal leverage that equates the marginal benefit of debt to the marginal cost of debt. This was contradicted by Modigliani and Miller (1958) who argued that the value of a firm is independent of its capital structure. However Myers (1977) asserted that high leveraged firms have an opportunity cost of forgoing projects with a positive net present value. Gomes and Schmid (2010) acknowledged the complexity of the relationship between leverage and stock returns and affirmed that the relationship depends on the firms' investment opportunities. The role of leverage on the stock returns depends on the degree of competition in the capital markets as information asymmetry under imperfect capital markets affects the cost of capital of firms (Lambert, Leuz & Verrecchia, 2012).

The effects of leverage on stock returns can either be positive or negative as higher debt increases the uncertainty of gaining returns and on the other hand they increases returns (Kartikasari and Merianti, 2016). Together with liquidity highly leveraged and liquid stock markets are have a significant positive relationship with stock returns as the easier and tradable asset increases the incentive of investing in long term projects (Levine & Zervos, 1998). According to Kartikasari and Merianti (2016) if leverage is properly managed to generate profits it is positively related with stock returns and this is in line with Devi and Devi (2014) and Singapurwoko and El-Wahid (2011). Vinasithamby (2015) argued that too much leverage reduces profitability as the firm pays too much interest on debt reducing returns on stocks. Applying ordinary least squares in Ghana (Acheampong, Agalega & Shibu, 2014) found that for the firms under study leverage had undetermined relationship with stock returns as nature of debt (short terms versus long term debt) played a role in determining the significance of leverage.

The gross domestic product (GDP) as measure of economic activity of the economy can improve corporate profitability implying a positive relationship between GDP and stock returns (Sharma, 2002). However, Kirui et al., (2014) concluded the TGARCH study of the Nairobi stock exchange by stating that for the period January 2000 to June 2012, GDP had no significant influence in determining stock market returns in Kenya despite GDP having a significant influence on the volatility of the

returns. This was in contrast to (Sharma 2002,) who found a significant positive relationship between GDP and stock market. Asgharin, Hou and Javed (2013) using the GARCH-MIDAS (mixed data sampling) econometric approach confirmed a positive relationship between the stock returns and gross domestic product. Using the industrial production index as a proxy for GDP and applying vector auto regression analysis four Latin American countries Abugri stated that the industrial production had a positive relationship with stock returns in Brazil, Chile and Argentina as an increase in the cash flows of companies increases the returns on stocks although it was insignificant in Mexico.

High interest rate increases the cost of borrowing of corporates this in turn affects the profitability of a firm and its return and the role of interest rate is mainly through the inflationary and discount factor effects (Abugri, 2008). Using the cointegration and error correction test in Ghana Kyereboah-Coleman and Agyire-Tettey (2008) found that the interest rate were the most significant factor in determining the return of stocks in Ghana as they negatively hindered the growth of businesses in Ghana. Chinzara (2011) confirmed the role of interest rates applying an augmented autoregressive Generalised Autoregressive Conditional Heteroscedasticity (AR-GARCH) and vector auto regression on the South African data, and concluded that short term interest rates had the largest negative impact on stock returns. According to Nkoro and Uko (2013) high interest rates can result in investors to diversify from the stock market to the bond markets reducing the return of stocks. This confirmed the study by Fama and Schwert (1977) who reported a significant negative relationship between interest rate and stock returns. The ARDL technique applied to test the significance of macroeconomic variables in determining the stock returns in India concluded that interest rate has a significant negative relationship with stock returns (Bhattacharya, 2014). The higher interest rate in India was negatively related to stock returns as it reduces the equity value and a switch by investors to fixed income securities (Bhattacharya, 2014). This was contrasted by Kirui et al. (2014) as the impulse response function applied to interest rate shock had no significant influence on returns in Kenya. These studies used different methodologies in different economies and this can be the reason of the differences.

3. Methodology

This section focuses on the research design, data and data sources model specification and the description of the models used in the study. The autoregressive distributed-lags (ARDL)-Bound testing approach is used to determine the long run and short run relationships of the variables under study. The study further discusses the unrestricted vector error correction model (UVECM) which will be discussed in detail in the later sections. The generalised autoregressive conditional

heteroscedasticity (GARCH) model is used to determine the effects of the macroeconomic variables on the volatility of stock return.

The study adopts the quantitative research to determine the macroeconomic variables that affects the stock returns of South African companies that are listed on the Johannesburg Stock Exchange (JSE). A regression analysis is used to ascertain the relationship between stock return and the selected macroeconomic variables as applied by (Coleman & Tettey, 2003; Elly & Orio, 2012; Kirui et al., 2014). A descriptive research was used to address some of the objectives of this paper[1]. The descriptive research has the advantages that it can be generalised to a larger population (Castro, 2012). Measurement and description of variables is outlined in table 1.

Table 1. Description and the expected return of variables

Variable	Description	Expected sign
Stock return	Stock indices of the JSE All Share index/ JSE40	
Inflation	General increase in the prices of goods and services and it is measured by the consumer price index (CPI)	-
Gross domestic product	Monetary value of all goods and services produced within a country i.e. it is a measure of the level of economic activity of a country	+
Interest rate	The cost of funds. Prime interest rate was used as the interest rate measure	-
Leverage	The level at which firms uses borrowed funds for investment expecting profits that are greater than the payable interest. Debt-equity ratio is used as a proxy for leverage	+/-
Exchange rate	It is the price of a nation's currency in terms of another	-

Secondary data obtained from the South Africa Reserve Bank (SARB), JSE and Statistics South Africa websites was used for this paper. The paper used quarterly data from 1995Q4– 2015Q4.

Since the data is time series data problems of non-stationarity may arise and this is regarded as the data has a unit root (Dickey and Fuller, 1981). The data is tested for the presence of unit root to avoid spurious regression results (Granger, 2001).

[1] see (Chkili, 2012; Kirui et al., 2014).

Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1981) and Phillips and Perron (1988) are used to determine the presents of a unit root in the series. The Philips-Perron test are more robust with serial correlation in the residuals which is a weakness of the Dickey-Fuller tests although they yield the same result (Wooldridge, 2012: 642; Brooks, 2015: 363; Chkili, 2012). Although the bound test of cointegration does not require the testing of the unit root, the test is carried out as the ARDL cannot be applied to data that has higher order of integration i.e. second order integration [I (2)] and beyond.

3.5. Model Specification

When determining the relationship between the variables in question, the stock returns are specified as a function of selected macroeconomic variables.

$$R = f(REER, GDP, INT, INF, Lev)$$

where R= stock return, REER= real effective exchange rate, GDP= gross domestic product, INT= interest rate, INF= inflation and Lev= Leverage.

The functional form of returns highlighted above is specified as a linear function of the selected macroeconomic variables. Thus,

$$R_t = \beta_t + \beta_1 Reer_t + \beta_2 GDP_t + \beta_3 INT_t + \beta_4 INF_t + Lev_t + \varepsilon_t.$$

Diagnostic tests were applied to the above linear model before it was estimated. To avoid spurious results of the regression analysis the data were tested for autocorrelation, multicollinearity and heteroscedasticity. The Breusch-Godfrey test was used to test for serial correlation. A correlation matrix was used to detect any multicollinearity of the variables.

The Ordinary Least Squares method (OLS) was applied on the multiple regression to determine the nature of the relationship between the dependent and the independent variables.

3.5.1. Autoregressive Distributed-Lags (ARDL)

The Autoregressive Distributed-Lags (ARDL) of Pesaran and Shin (1997) model is used to determine the long run relationship between the selected macroeconomic variables and stock returns. The ARDL Bound Test model based on the unrestricted error correction model (UECM) has the advantages that it uses both the lagged and differenced variables and it determines the explanatory strengths of the exogenous variables (Elly & Orio, 2012). The model further advantage is that it does not impose restrictive assumption of the same order of integration on the regressors (Pesaran 1999; Pesaran et al., 2001; Odhiambo, 2010). The lagged variables and the differenced variables test the long run and short run relationships of the variables respectively.

Using the ARDL with an unrestricted ECM the model specification is as follows

$$\Delta R_{it} = \beta_0 + \beta_1 R_{t-1} + \beta_2 REER_{t-1} + \beta_3 GDP_{t-1} + \beta_4 INT_{t-1} + \beta_5 INF_{t-1} + \beta_6 Lev_{t-1} + \sum_{i=0}^{n} \beta_{1i} \Delta R_{t-1} + \sum_{i=0}^{n} \beta_{2i} \Delta REER_{t-1} + \sum_{i=0}^{n} \beta_{3i} \Delta GDP_{t-1} + \sum_{i=0}^{n} \beta_{4i} \Delta INT_{t-1} + \sum_{i=0}^{n} \beta_{5i} \Delta INF_{t-1} + \sum_{i=0}^{n} \beta_{6i} \Delta Lev_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta Exch_{it} = \beta_0 + \beta_1 REER_{t-1} + \beta_2 R_{t-1} + \beta_3 GDP_{t-1} + \beta_4 INT_{t-1} + \beta_5 INF_{t-1} + \beta_6 Lev_{t-1} + \sum_{i=0}^{n} \beta_{1i} \Delta Exch_{t-1} + \sum_{i=0}^{n} \beta_{2i} \Delta R_{t-1} + + \sum_{i=0}^{n} \beta_{3i} \Delta GDP_{t-1} + \sum_{i=0}^{n} \beta_{4i} \Delta INT_{t-1} + \sum_{i=0}^{n} \beta_{5i} \Delta INF_{t-1} + \sum_{i=0}^{n} \beta_{6i} \Delta Lev_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta GDP_{it} = \beta_0 + \beta_1 GDP_{t-1} + \beta_2 REER_{t-1} + \beta_3 R_{t-1} + \beta_4 INT_{t-1} + \beta_5 INF_{t-1} + \beta_6 Lev_{t-1} + \sum_{i=0}^{n} \beta_{1i} \Delta GDP_{t-1} + \sum_{i=0}^{n} \beta_{2i} \Delta REER_{t-1} + \sum_{i=0}^{n} \beta_{3i} \Delta R_{t-1} + \sum_{i=0}^{n} \beta_{4i} \Delta INT_{t-1} + \sum_{i=0}^{n} \beta_{5i} \Delta INF_{t-1} + \sum_{i=0}^{n} \beta_{6i} \Delta Lev_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta \mathrm{INT}_{it} = \beta_0 + \beta_1 \mathrm{I}_{t-1} + \beta_2 \mathrm{GDP}_{t-1} + \beta_3 \mathrm{REER}_{t-1} + \beta_4 \mathrm{R}_{t-1} + \beta_5 \mathrm{INF}_{t-1} + \beta_6 \mathrm{Lev}_{t-1} + \sum_{i=0}^{n} \beta_{1i} \Delta \mathrm{I}_{t-1} + \sum_{i=0}^{n} \beta_{2i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \beta_{3i} \Delta \mathrm{REER}_{t-1} + \sum_{i=0}^{n} \beta_{4i} \Delta \mathrm{R}_{t-1} + \sum_{i=0}^{n} \beta_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \beta_{6i} \Delta \mathrm{Lev}_{t-1} + \varepsilon_t \quad (4)$$

$$\Delta \mathrm{INF}_{it} = \beta_0 + \beta_1 \mathrm{INF}_{t-1} + \beta_2 \mathrm{INT}_{t-1} + \beta_3 \mathrm{GDP}_{t-1} + \beta_4 \mathrm{REER}_{t-1} + \beta_5 \mathrm{R}_{t-1} + \beta_6 \mathrm{Lev}_{t-1} + \sum_{i=0}^{n} \beta_{1i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \beta_{2i} \Delta \mathrm{INT}_{t-1} + \sum_{i=0}^{n} \beta_{3i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \beta_{4i} \Delta \mathrm{REER}_{t-1} + \sum_{i=0}^{n} \beta_{5i} \Delta \mathrm{R}_{t-1} + \sum_{i=0}^{n} \beta_{6i} \Delta \mathrm{Lev}_{t-1} + \varepsilon_t \quad (5)$$

$$\Delta \mathrm{Lev}_{it} = \beta_0 + \beta_1 \mathrm{Lev}_{t-1} + \beta_2 \mathrm{INF}_{t-1} + \beta_3 \mathrm{INT}_{t-1} + \beta_4 \mathrm{GDP}_{t-1} + \beta_5 \mathrm{REER}_{t-1} + \beta_6 \mathrm{R}_{t-1} + \sum_{i=0}^{n} \beta_{1i} \Delta \mathrm{Lev}_{t-1} + \sum_{i=0}^{n} \beta_{2i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \beta_{3i} \Delta \mathrm{INT}_{t-1} + \sum_{i=0}^{n} \beta_{4i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \beta_{5i} \Delta \mathrm{REER}_{t-1} + \sum_{i=0}^{n} \beta_{6i} \Delta \mathrm{R}_{t-1} + \varepsilon_t \quad (6)$$

Where, Δ is the difference operator. The respective dependent variable are *R*= stock return, REER= real effective exchange rate, GDP= gross domestic product, INT= interest rate, INF= inflation and Lev= Leverage

3.5.2. Vector Error Correction Model (VECM)

The scope of this study is not only limited to establishing the long run relationship between the variables hence the short run effects of the selected macroeconomic variables is empirically determined using the vector error correction model (VECM). The model using the VECM is thus specified as:

$$\Delta R_{it} = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i} \Delta R_{t-1} + \sum_{i=0}^{n} \alpha_{2i} \Delta REER_{t-1} + \sum_{i=0}^{n} \alpha_{3i} \Delta GDP_{t-1} + \sum_{i=0}^{n} \alpha_{4i} \Delta INT_{t-1} + \sum_{i=0}^{n} \alpha_{5i} \Delta INF_{t-1} + \sum_{i=0}^{n} \alpha_{6i} \Delta Lev_{t-1} + \alpha_7 ECT_{t-1} + \varepsilon_t \quad (7)$$

$$\Delta REER_{it} = \sigma_0 + \sum_{i=0}^{n} \sigma_{2i} \Delta REER_{t-1} + \sum_{i=0}^{n} \sigma_{1i} \Delta R_{t-1} + \sum_{i=0}^{n} \sigma_{3i} \Delta GDP_{t-1} + \sum_{i=0}^{n} \sigma_{4i} \Delta INT_{t-1} + \sum_{i=0}^{n} \sigma_{5i} \Delta INF_{t-1} + \sum_{i=0}^{n} \sigma_{6i} \Delta Lev_{t-1} + \beta_7 ECT_{t-1} + \varepsilon_t \quad (8)$$

$$\Delta GDP_{it} = \lambda_0 + \sum_{i=0}^{n} \sigma_{2i} \Delta GDP_{t-1} + \sum_{i=0}^{n} \sigma_{1i} \Delta R_{t-1} + \sum_{i=0}^{n} \sigma_{3i} \Delta REER_{t-1} + \sum_{i=0}^{n} \sigma_{4i} \Delta INT_{t-1} + \sum_{i=0}^{n} \sigma_{5i} \Delta INF_{t-1} + \sum_{i=0}^{n} \sigma_{6i} \Delta Lev_{t-1} + \beta_7 ECT_{t-1} + \varepsilon_t \quad (9)$$

$$\Delta I_{it} = \delta_0 + \sum_{i=0}^{n} \delta_{1i} \Delta INT_{t-1} + \sum_{i=0}^{n} \delta_{2i} \Delta GDP_{t-1} + \sum_{i=0}^{n} \delta_{3i} \Delta R_{t-1} + \sum_{i=0}^{n} \delta_{4i} \Delta REER_{t-1} + \sum_{i=0}^{n} \delta_{5i} \Delta INF_{t-1} + \sum_{i=0}^{n} \delta_{6i} \Delta Lev_{t-1} + \delta_7 ECT_{t-1} + \varepsilon_t \quad (10)$$

$$\Delta \mathrm{INF}_{\mathrm{it}} = \boldsymbol{\phi_0} + \sum_{i=0}^{n} \boldsymbol{\phi}_{1i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \boldsymbol{\phi}_{2i} \Delta \mathrm{INT}_{t-1} + \sum_{i=0}^{n} \boldsymbol{\phi}_{3i} \Delta \mathrm{R}_{t-1} + \sum_{i=0}^{n} \boldsymbol{\phi}_{4i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \boldsymbol{\phi}_{5i} \Delta \mathrm{REER}_{t-1} + \sum_{i=0}^{n} \boldsymbol{\phi}_{6i} \Delta \mathrm{Lev}_{t-1} + \boldsymbol{\phi}_7 ECT_{t-1} + \varepsilon_t \quad (11)$$

$$\Delta \mathrm{Lev}_{\mathrm{it}} = \psi_0 + \sum_{i=0}^{n} \psi_{1i} \Delta \mathrm{Lev}_{t-1} + \sum_{i=0}^{n} \psi_{2i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \psi_{2i} \Delta \mathrm{INT}_{t-1} + \sum_{i=0}^{n} \psi_{3i} \Delta \mathrm{R}_{t-1} + \sum_{i=0}^{n} \psi_{4i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \psi_{5i} \Delta \mathrm{REER}_{t-1} + \psi_7 ECT_{t-1} + \varepsilon_t \quad (12)$$

3.5.2. Generalised Autoregressive Conditional Heteroscedasticity (GARCH 1,1)

Generalised Autoregressive Conditional Heteroscedasticity (GARCH) method was used to establish the effect of the macroeconomic variables on the volatility of the stock returns. The GARCH model was the most appropriate model to use to capture the leverage effects of stock returns[1]. Specifically, Engle's (2002) GARCH model was adapted to analyse the gearing effects on stock returns because of its merits: Firstly, it enables one to observe the pair-wise conditional correlation coefficients for the index returns under scrutiny. Secondly, the methodology allows the researcher to examine the correlations amongst the variable during different regimes, for example we can have a better view of periods that preceded the 2007/09 financial crisis and also what transpired during the period of crisis. Lastly, the model also allows the writer to investigate the linkages between leverage and stock return volatility. The GARCH (1, 1) model is presented in the following variance equation and the test results are provided subsequently.

$$\delta_t^2 = \phi + \beta \delta_{t-1}^2 + \gamma \varepsilon_{t-1}^2 + \varphi \sum_{j=1}^{n} Lev_j \quad (13)$$

Where δ_t^2 is the error term derived from the A (L) which is the lag polynomial, ϕ is a constant, the δ_{t-1}^2 is the squared residual from time (t-1) as derived from the A (L) model which is the previous month's stock returns volatility of South African stock market i.e. the ARCH term, and Lev_j is the leverage level of the south African firms listed on the stock exchange. The inferred results of the Z-statistic are based on three

[1] See (Zakoian, 1994; Chen, Gerlach & Lin, 2008).

types of distribution and these include: Normal Gaussian distribution, Student's t with fixed df, and the Generalized Error Distribution assumption.

This section focused on the research design, data and data sources and data analysis. The next section is the results of the regression analysis and a discussion on the empirical results.

4. Empirical Analysis and Results

Table 3. Correlation results

	JSEALL	LRGDP	CPI	DTA	DTE	INT	REER	LF
JSEALL	1	-0.62583	0.004739	-0.42059	-0.20152	0.502061	0.013955	0.069047
LRGDP	-0.62583	1	0.056627	0.37767	0.254175	-0.76691	-0.07983	-0.05188
CPI	0.004739	0.056627	1	-0.01175	-0.14809	0.478318	0.097703	-0.11505
DTA	-0.42059	0.37767	-0.01175	1	0.617442	-0.29073	-0.00626	0.09185
DTE	-0.20152	0.254175	-0.14809	0.617442	1	-0.37497	-0.01264	0.78242
INT	0.502061	-0.76691	0.478318	-0.29073	-0.37497	1	0.143196	-0.1653
REER	0.013955	-0.07983	0.097703	-0.00626	-0.01264	0.143196	1	0.066168
LF	0.069047	-0.05188	-0.11505	0.09185	0.78242	-0.1653	0.066168	1

Source: Eviews 9.5

Table 4. OLS regression Results

Dependent Variable: JSE40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.086220	0.862178	3.579564	0.0007
INT	-0.009944	0.003261	-3.049674	0.0033
EXCH	0.000657	0.000991	0.663573	0.5094
DTE	-0.074469	0.070445	-1.057125	0.2945
LRGDP(-1)	-0.218948	0.062407	-3.508375	0.0008
R-squared	0.179822	Mean dependent var		0.035422
Adjusted R-squared	0.127747	S.D. dependent var		0.057743
S.E. of regression	0.053929	Akaike info criterion		-2.931623
Sum squared resid	0.183223	Schwarz criterion		-2.768424
Log likelihood	104.6752	Hannan-Quinn criter.		-2.866959
F-statistic	3.453152	Durbin-Watson stat		1.879975
Prob(F-statistic)	0.012938			

Source: Eviews 9.5

Interest rates have a significant negative relationship with the stock returns. This relationship was as expected as the interest rate reflects the cost of borrowing. The integration in the financial market provides alternative investment opportunities than stock (Johnson, 2015). Johnson et al., (2015) observed that the trend of the interest rates is more important than the level of interest rates in determining the stock returns. For this study 21.89% of changes in the stock returns are explained by the previous period real gross domestic product. For this study stock returns and exchange rate have an insignificant positive relationship. These results are consistent with the findings of Bahmani-Oskooee and Sohrabian (1995); Nieh and Lee (2002); Phylaktis and Ravazzolo (2005) and Singh (2015). However this contrasted the negative relationship finding of Tsai (2012).

4.1. Test of stationarity

Stationarity tests of variables on first difference – Augmented Dickey Fuller (ADF) test and Phillips-Perron (PP) test.

Table 5. ADF results

Variable	No trend	Trend	Intercept
Stationary tests of variables on fist difference – **Augmented Dickey Fuller (ADF) test**			
JSEAll	-14.49019***	-14.87975***	-14.88635***
RGDP	-12.73245 ***	-14.13770***	-14.22940***
JSE40	-8.272898***	-8.167682***	-8.220971***
REER	-12.00175***	-11.86225***	-11.92195***
CPI	-5.715878***	-5.642339***	-5.678073***
INT	-5.985141***	-5.961880***	-5.994673***
DTA	-8.062258***	-8.641033***	-8.092780***
DTE	-8.062258***	-7.952346***	-8.004932***
LF	-8.062258***	-8.089777***	-8.000237***
Stationary tests of variables on fist difference – **Phillips – Perron (PP) test**			

Table 6. PP results

JSEAll	-8.062258***	-8.089758***	-8.000237***
RGDP	-11.98001***	-19.83719***	-19.95813***
JSE40	-16.35992***	-17.34816***	-16.41537***
REER	-30.09029***	-29.79251***	-29.82995***
CPI	-4.686376***	-4.617213***	-4.651885***
INT	-5.707364***	-5.639768***	-5.685616***
DTA	-8.062258***	-9.526920***	-8.092775***
DTE	-8.062258***	-7.952346***	-8.004932***
LF	-8.062258***	-8.089758***	-8.000237***

**** Denotes 1% level of significance*

Source: Eviews 9.5

Given the result in the table above the hypothesis that first difference of all variables under consideration has unit roots can be rejected. Therefore, we can proceed and use ARDL model to test for any cointegration relationship amongst these variables.

4.2 Cointegration

The cointegration of the explanatory variables and stock returns is determined using the ARDL bounds testing technique. Before the estimation of equation 14 below the lag order was first estimated and the results are in in Table 6 with an optimal lag of 1.

4.3.1 VAR Lag Order Selection Criteria

Table 7. Endogenous variables: JSEALL REER RGDP CPI INT DTA DTE LF

Lag	LogL	LR	FPE	AIC
0	-179.1731	NA	4.38e-08	5.759173
1	207.6601	666.5434*	2.16e-12*	-4.174158*

* indicates lag order selected by the criterion

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

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The Wald coefficient diagnostic test was applied to obtain the F-test of which the F value was used for the Bounds tests. The F-test is to determine whether a long run relationship exist between the variables under study. The results of coefficient diagnostic tests are in Table 9.

d(jseall) jseall(-1) cpi(-1) rgdp(-1) int(-1) dta(-1) dte(-1) lf(-1) reer(-1) d(jseall(-1)) d(cpi(-1)) d(rgdp(-1)) d(int(-1)) d(dta(-1)) d(dte(-1)) d(lf(-1)) d(reer(-1)) c @trend……(14)

Table 8. ARDL results with trend

Dependent variable: D(JSEALL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
JSEALL(-1)	-3.452336	0.358288	-9.635639	0.0000
CPI(-1)	-2.45E-06	1.01E-05	-0.243021	0.8091
RGDP(-1)	-6.27E-10	1.24E-09	-0.505318	0.6157
INT(-1)	0.000135	0.001613	0.083569	0.9338
DTA(-1)	0.001789	0.000837	2.137005	0.0379
DTE(-1)	-0.000518	0.000518	-0.999962	0.3226
LF(-1)	-7.79E-05	0.000396	-0.196962	0.8447
REER(-1)	3.29E-06	4.24E-06	0.776671	0.4413
D(JSEALL(-1))	1.265988	0.260398	4.861752	0.0000
D(CPI(-1))	7.29E-06	1.23E-05	0.591567	0.5570
D(RGDP(-1))	1.56E-09	1.01E-09	1.538141	0.1309
D(INT(-1))	0.002074	0.002375	0.873216	0.3871
D(DTA(-1))	-0.002932	0.001504	-1.950002	0.0573
D(DTE(-1))	0.000822	0.000697	1.178783	0.2445
D(LF(-1))	-0.000179	0.000500	-0.358678	0.7215
D(REER(-1))	-2.00E-07	2.66E-06	-0.074979	0.9406
C	0.009102	0.000989	9.202232	0.0000
@TREND	-1.51E-05	7.85E-06	-1.926941	0.0602

R-squared	0.885327	Mean dependent var	-5.46E-06
Adjusted R-squared	0.842948	S.D. dependent var	0.000228
S.E. of regression	9.04E-05	Akaike info criterion	-15.55152
Sum squared resid	3.76E-07	Schwarz criterion	-14.94433
Log likelihood	515.6486	Hannan-Quinn criter.	-15.31232
F-statistic	20.89066	Durbin-Watson stat	2.224012
Prob(F-statistic)	0.000000		

Source: Eviews 9.5

Equation 14 above was estimated using the OLS method and the trend was not significant at 5% hence it was removed. The estimation of equation 15 without the trend is given in Table 10 below.

d(jseall) jseall(-1) cpi(-1) rgdp(-1) int(-1) dta(-1) dte(-1) lf(-1) reer(-1) d(jseall(-1)) d(cpi(-1)) d(rgdp(-1)) d(int(-1)) d(dta(-1)) d(dte(-1)) d(lf(-1)) d(reer(-1)) c…..(15)

Table 9. Results without trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(JSEALL)	1.98E-10	3.96E-11	5.004858	0.0000
JSEALL(-1)	9.43E-10	1.56E-10	6.039491	0.0000
CPI(-1)	-3.31E-15	2.80E-15	-1.184028	0.2425
RGDP(-1)	1.11E-18	1.72E-19	6.479189	0.0000
INT(-1)	3.48E-13	3.92E-13	0.887546	0.3794
DTA(-1)	-7.99E-14	1.83E-13	-0.437280	0.6640
DTE(-1)	-1.24E-13	1.34E-13	-0.927268	0.3586
LF(-1)	2.58E-13	1.09E-13	2.368009	0.0221
REER(-1)	-4.10E-16	1.09E-15	-0.374906	0.7095
D(JSEALL(-1))	-4.20E-10	7.88E-11	-5.337102	0.0000
D(CPI(-1))	1.87E-15	3.43E-15	0.544111	0.5890
D(RGDP(-1))	-7.76E-19	2.35E-19	-3.297082	0.0019
D(INT(-1))	-6.49E-13	6.59E-13	-0.985493	0.3295
D(DTA(-1))	7.28E-14	4.34E-13	0.167624	0.8676
D(DTE(-1))	3.39E-14	1.97E-13	0.172161	0.8641
D(LF(-1))	-1.07E-13	1.40E-13	-0.762905	0.4494
D(REER(-1))	3.53E-16	7.27E-16	0.486062	0.6292
C	1.000000	4.52E-13	2.21E+12	0.0000
Mean dependent var	1.000000	S.D. dependent var		0.000000
S.E. of regression	2.52E-14	Sum squared resid		2.93E-26
Durbin-Watson stat	1.276428			

Source: Eviews 9.5

4.2.2 WALD coefficient diagnostic test

The Wald coefficient diagnostic test was done to confirm that the coefficients are significantly different from zero. The results thereof are in table 11

C(1)= C(2)= C(3)= C(4)= C(5)= C(6)= C(7)= C(8)=0

Results without trend

Table 10. Wald Test

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	11.77523	(8, 47)	0.0000
Chi-square	94.20185	8	0.0000

Null Hypothesis: C(1)= C(2)= C(3)= C(4)= C(5)= C(6)= C(7)=C(8)=0

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	-3.183698	0.339445
C(2)	-5.30E-06	1.03E-05
C(3)	-2.85E-09	4.79E-10
C(4)	0.001739	0.001420
C(5)	0.000762	0.000664
C(6)	-0.000142	0.000493
C(7)	-0.000222	0.000399
C(8)	1.79E-07	4.03E-06

Source: Eviews 9.5

Restrictions are linear in coefficients. The Bounds Tests was performed based on the results of the Wald test statistic.

4.2.3 Autoregressive Distributed Lags (ARDL) - Bound test Results

Case III of Pesaran et al., (2001: 303) was used to determine the bounds for this study. The F tests of 11.77 from the Wald test falls outside the bounds of -2.57 -4.40 at 1% significance level. Hence the study concluded that there was cointegration. A piecemeal approach was used in estimating equation 14. None significant variables were removed in the final results on the cointegration in Table 11.

Table 11. Results after the piecemeal approach

Dependent Variable: D(JSEALL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
JSEALL(-1)	-2.714392	0.259267	-10.46949	0.0000
RGDP(-1)	-2.59E-09	2.88E-10	-9.002101	0.0000
INT(-1)	0.001497	0.000488	3.068477	0.0031
D(JSEALL(-1))	0.842124	0.165138	5.099514	0.0000
D(RGDP(-1))	2.43E-09	6.80E-10	3.567355	0.0007
C	0.007794	0.000747	10.42833	0.0000
R-squared	0.817198	Mean dependent var		-5.88E-06
Adjusted R-squared	0.804140	S.D. dependent var		0.000209
S.E. of regression	9.27E-05	Akaike info criterion		-15.65972
Sum squared resid	6.01E-07	Schwarz criterion		-15.47571
Log likelihood	601.0693	Hannan-Quinn criter.		-15.58618
F-statistic	62.58545	Durbin-Watson stat		1.880571
Prob(F-statistic)	0.000000			

This study confirms the theoretical underpinnings that there is a lag on the influence of the macroeconomic on stock returns. The previous period stock returns and GDP have a negative long run relationship with stock returns. On the other hand interest rate has a long run positive relationship with stock returns. Real GDP significantly affects stock returns as expected however, the negative sign was not expected for this study.

Analysing emerging market Ritter (2005) observed that the real GDP do not translate to high returns. It was argued in the study that high economic growth as much as it improves welfare it does not increase the net worth of capital owners. Although the negative relationship was not expected Ritter (2005) found negative relationship between stock returns and gross domestic product in emerging markets. Henry and Kannan (2008) observed that the expected stock returns can differ significantly from actual returns. For the reference period of this study the negative relationship between stock returns and real GDP although expected to be positive the actual realised returns were negatively related to real GDP. Although significant the relationship is not robust and this finding is consistent with the finding of Levine and Zervos (1998). The negative relationship between real GDP and stock returns can be explained by the speculative euphoria in financial markets during periods of economic boom.

The leverage as reflected by the debt to equity ratio is insignificant although it is negative as was expected. Robust financial intermediation and integration in South Africa allow for international risk sharing with the global market such that the significance of debt in explaining stock returns is not that robust. The negative results in consistent with the previous work of Korteweg (2004), Dimitrov and Jain (2005) and Penn (2007).

Table 12. Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.484453	Prob. F(1,69)	0.4888
Obs*R-squared	0.529880	Prob. Chi-Square(1)	0.4667

Source: Eviews 9.5

We fail to reject the null hypothesis and conclude that there is no serial correlation. Cusum results in Figure 1 suggested that the model is stable.

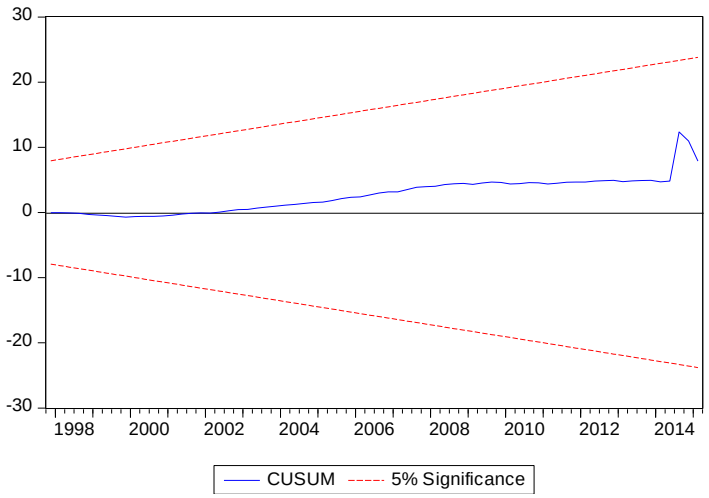

Figure 1

Source: Eviews 9.5

4.3. Vector Error Correction Model (VECM)

The bounds testing results confirmed the presents of cointegration hence the study used VECM to determine the short run and the long run relationship in the variables. After the piecemeal approach the VECM results are in Table 13.

Table 13. Dependent Variable: D(JSE40)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.329957	0.096437	-3.421488	0.0012
D(JSE40(-1))	0.232016	0.126952	1.827592	0.0729
D(JSE40(-2))	0.278992	0.119589	2.332923	0.0233
D(RGDP(-1))	-6.80E-07	2.86E-07	-2.373810	0.0211
D(RGDP(-2))	-5.38E-07	3.06E-07	-1.760491	0.0838
D(REER(-1))	0.003085	0.001135	2.717781	0.0087
D(REER(-2))	0.002102	0.000863	2.436290	0.0180
D(CPI(-1))	-0.008369	0.004483	-1.866928	0.0671
D(CPI(-2))	0.017538	0.004200	4.175625	0.0001
D(DTE(-1))	0.280758	0.087994	3.190633	0.0023
R-squared	0.404985	Mean dependent var		-0.002088
Adjusted R-squared	0.309358	S.D. dependent var		0.044641
S.E. of regression	0.037099	Akaike info criterion		-3.611748
Sum squared resid	0.077073	Schwarz criterion		-3.279982
Log likelihood	129.1877	Hannan-Quinn criter.		-3.480651
Durbin-Watson stat	1.980208			

Source: Eviews 9.5

The results of VECM in table 13 suggests that the error correction term is negative (-0.329957) and significant at 1% significance level. The speed of adjustment of the model after disequilibrium within a year is 33%

4.4 4.4. Generalised Autoregressive Conditional Heteroscedasticity (GARCH 1,1)

The results are summarised in table 14.

Table 14. Z-statistic for ARCH and GARCH test: Dependent variable (JSE All-share index)

Independent variable	**Coefficient**	**z-statistic** *Normal distribution*	**z-statistic** *Student's t distribution*	**z-statistic** *Generalized error distribution*
Leverage	ϕ	2.937322***	2.667512***	2.874480***
	γ	1.898578**	1.701125*	1.847499*
	β	3.079596***	2.815113***	2.887109***
	φ	-4.119183***	-3.223897***	-3.694079***
	Robust test	NS/NA	NS/NA/RN	NS/NA/RN

**** shows 1% level of significance, ** shows 5% level of significance, and * indicate 10% level of significance. NS denotes No serial correlation, NA indicate that there is no ARCH effect, and RN denotes that the residual is normally distributed using Jarque-Bera statistic*

The Table 1 above summarises the Z-statistic for ARCH and GARCH test for leverage factor relative to the JSE All Share Index. The results show that the GARCH effect is significant under all the distribution models. This shows the persistence of the GARCH effect meaning that the period (t-1) stock returns volatility influences positively time (t) stock returns volatility. The ARCH coefficient is significant at 5% under the normal distribution and at 10% under the other distributions and indication that previous period stock returns has influence on subsequent period stock returns. Lastly**,** results shows that leverage significant influence stock market price volatility. The JSE stock returns volatility is heavily dependent on the gearing ratio. This confirms the preposition that high leverage associated with high volatility.

5. Conclusion

This paper determined the relationship between the macroeconomic variables, leverage and the stock returns on JSE. The study revealed that there is a lag effect on the effect of the macroeconomic variables on the behavior of stock returns. Previous period real GDP and interest rate affects stock returns after the piecemeal approach. Furthermore, our findings show that leverage affects the volatility of stock prices. The study fills the gap by using the ARDL bounds testing approach to provide recent information on the macroeconomic effects on stock returns on JSE. There is a long run relationship between stock returns and the previous period returns, real GDP, interest rate. In addition, after disequilibrium the economic will always adjust to equilibrium within a year.

Since leverage positively influence volatility in stock returns we recommend that investors which are risk averse should avoid highly geared firms. More so, given that there is co-integrating relationship between stock returns and other macro-economic variables, investors and finance professionals can include these variables when developing models to predict stock returns in the long run.

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