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

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

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

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

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

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

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

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:

$$\Delta \mathrm{R}_{it} = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i} \Delta \mathrm{R}_{t-1} + \sum_{i=0}^{n} \alpha_{2i} \Delta \mathrm{REER}_{t-1} + \sum_{i=0}^{n} \alpha_{3i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \alpha_{4i} \Delta \mathrm{INT}_{t-1} + \sum_{i=0}^{n} \alpha_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \alpha_{6i} \Delta \mathrm{Lev}_{t-1} + \alpha_7 \mathrm{ECT}_{t-1} + \varepsilon_t \quad (7)$$

$$\Delta \mathrm{REER}_{it} = \sigma_0 + \sum_{i=0}^{n} \sigma_{2i} \Delta \mathrm{REER}_{t-1} + \sum_{i=0}^{n} \sigma_{1i} \Delta \mathrm{R}_{t-1} + \sum_{i=0}^{n} \sigma_{3i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \sigma_{4i} \Delta \mathrm{INT}_{t-1} + \sum_{i=0}^{n} \sigma_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \sigma_{6i} \Delta \mathrm{Lev}_{t-1} + \beta_7 ECT_{t-1} + \varepsilon_t \quad (8)$$

$$\Delta \mathrm{GDP}_{it} = \lambda_0 + \sum_{i=0}^{n} \sigma_{2i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \sigma_{1i} \Delta \mathrm{R}_{t-1} + \sum_{i=0}^{n} \sigma_{3i} \Delta \mathrm{REER}_{t-1} + \sum_{i=0}^{n} \sigma_{4i} \Delta \mathrm{INT}_{t-1} + \sum_{i=0}^{n} \sigma_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \sigma_{6i} \Delta \mathrm{Lev}_{t-1} + \beta_7 ECT_{t-1} + \varepsilon_t \quad (9)$$

$$\Delta I_{it} = \delta_0 + \sum_{i=0}^{n} \delta_{1i} \Delta \mathrm{INT}_{t-1} + \sum_{i=0}^{n} \delta_{2i} \Delta \mathrm{GDP}_{t-1} + \sum_{i=0}^{n} \delta_{3i} \Delta \mathrm{R}_{t-1} + \sum_{i=0}^{n} \delta_{4i} \Delta \mathrm{REER}_{t-1} + \sum_{i=0}^{n} \delta_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=0}^{n} \delta_{6i} \Delta \mathrm{Lev}_{t-1} + \delta_7 ECT_{t-1} + \varepsilon_t \quad (10)$$

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

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

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.

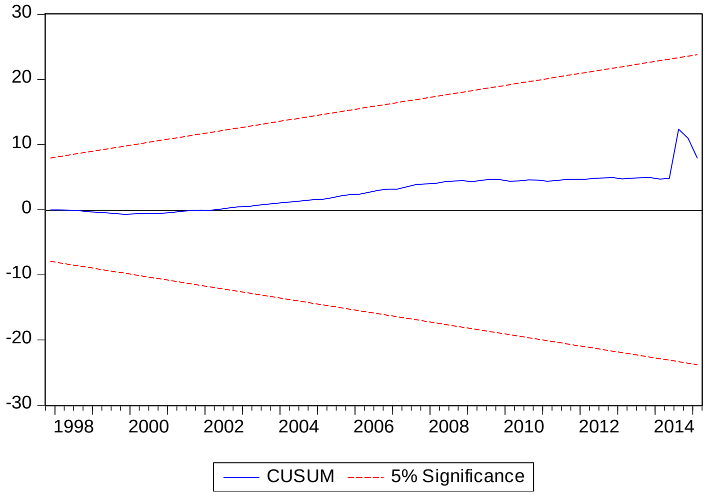

Figure 1

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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Is Maize Demand Irreversible in South Africa? Estimating the price elasticity using the Wolfram - Houck Procedure

John Khumalo[1]

Abstract: This research paper seeks to empirically estimate and test reversibility or non-reversibility of the maize demand using the Tweeten – Quance and Wolffram – Houck methodology in South Africa with the use of annualized seasonal data for the periods 1970/71 to 2012/13. The test procedure seems to hold in South Africa in the case of demand for maize and the function is found to be irreversible. This is shown by the coefficients of both the increases and decreases in the price of maize, which are found to be non-identical. The results indicate that when maize prices increase by 1%, demand for maize falls by almost 12%, while decreases in maize price drive demand up by nearly 20%. The structural VAR on the other hand, which assumes that innovations are proliferated in the maize demand, maize prices, wheat prices and income, indicates that the SVAR is just –identified. These results reveal that ignoring such structural changes when conducting policy changes might be detrimental to the agricultural sector.

Keywords: Maize prices; Non-reversible; Structural VAR; Innovation accounting, South Africa

JEL Classification: C13; C50; E3; Q11

1. Introduction

The economy of South Africa has experienced a number of political changes, political and economic instability in the past three decades. There has seen some agricultural reforms and changes hence some changes in total production. The agricultural sector, especially commercial farming is considered very important to the economy due to its contribution to the South Africa's gross domestic product (GDP). Maize is one of the top ten agricultural products in South Africa by value followed by wheat. The sector manages to produce quantities that could be said to be sufficient despite some major challenges such as the climate change that has seen several agricultural areas experience severe drought, which hampers maize production.

The year 1996 saw the abolishment of the maize marketing board and this allowed prices and production decisions to respond to market forces of demand and supply.

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The deregulation allowed producers to sell to whomever they wished, including the international markets. The maize production between the periods 1997 to 2012 is given on figure 1 below.

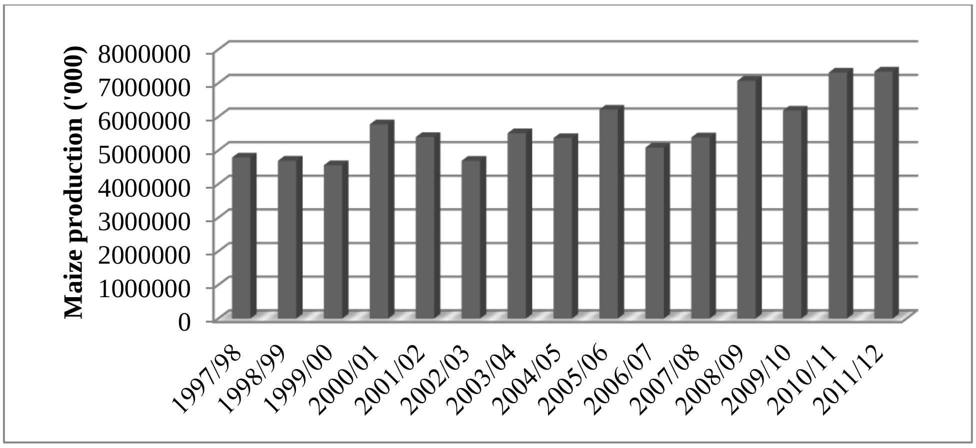

Figure 1. Maize production (1997–2012)

Source: Abstract of Agricultural Statistics 2013

The figure above highlights the production trends of maize and as depicted, production has been on the rise or simply fluctuating. The years 1997 – 1999 saw maize production averaging 4,681,667 tons with some increase of about 24 percent experienced in year 2000 and followed by decreases in 2001 and 2002. This shows that maize production has been highly volatile since its production depends largely on weather conditions. Favourable weather conditions (rainy) will see more output being produced.

Since the majority of maize output is aimed at commercial trading, the maize prices have been soaring to alarming heights. Chabane (2004) in her paper asserts that according to Naledi[1] (2002) apart from the weather conditions, producer prices have been on the upward trend and increased from R1200 per ton in September 2001 to R2500 in 2002, which is a whopping 108 percent. Increases like this translate into high maize prices to the consumers and this, in the long run might not be good the economy since the majority of the population depends largely on maize as their staple meal. The wholesale price trends for both the white and yellow maize are depicted in figure 2 below.

[1] National Labour & Economic Development Institute.

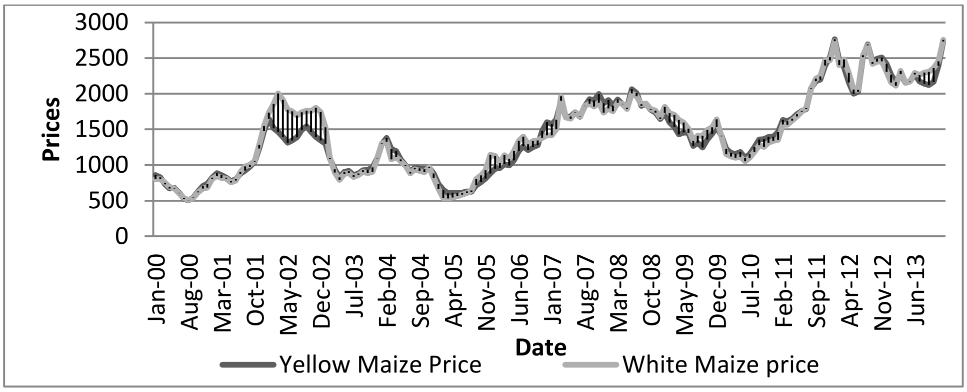

Figure 2. Maize prices

Source: FAOSTAT

In view of the significance of prices and other economic factors on the agricultural products in South Africa, several studies have touched on elasticities of agricultural products. One of such studies is by Roberts and Schlenker (2010), in which they tried to identify both the supply and demand elasticities of agricultural products in the USA. The estimated elasticities were used to evaluate the effect of subsidies on food prices and quantities. The results found that food prices would increase by about 30% as a result of subsidies. Another paper that attempted the effect of purchasing and price subsidy policies for agricultural products is by Chen *et al* (2014). In that study, Chen *et al* (2014) asserts that a good harvest would lead to fall in agricultural prices due to very low price elasticity and this gives rise to a reasonably high degree of disparity in prices.

The most recent study on South Africa is by Abidoye and Mabaya (2014), though not directly investigated the price transmission mechanism on maize consumption, it did highlight that the adoption of genetically modified crops did influence maize prices. The literature on the non-reversibility of maize or agricultural products was limited to the US economy and due to the demographic differences between the US economy and the developing economies, such studies cannot be generalised. This therefore compelled this study to test the validity of the Houck model.

2. Methodology

The main aim of this paper is to estimate the price elasticity of maize demand in South Africa using a non-reversible function. In an attempt to unpack the non-reversibility of maize demand in South Africa, we employ the Wolffram - Houck[1] procedure coupled with the structural vector autoregressive analysis in this study.

[1] See (Wolffram, 1971; Houck, 1977).

The study utilizes the annual data spanning from 1970/1971 to 2012/2013 for South Africa. This study therefore, adopts the non-reversibility method advocated by Tweeten and Quance (1969), which was backed by Wolffram (1971). The non-reversibility theorem asserts that the functions are expressed in terms of asymmetrical changes from past points of time. Houck (1977), however, indicated that segmenting the variables often hinges variations from the previous position and as a result the first observation had no descriptive power. He then improved on those two studies and came up with the Houck theorem, which this study utilized. The Houck procedure is explained below and it assumes that we have the dependent variable Y, which depends upon the values taken by X and that both these variable are time series variables. The hypothesis is that a one unit increase in X from one period to the next has a different contribution on Y than a one unit decrease in X does. This written algebraically as:

$$\partial Y_i = \varphi_0 + \varphi_1 \partial X_i^{'} + \varphi_2 \partial X_i^{''} \qquad (1)$$

For i = 1 , 2, 3, ………., t; where $\partial Y_i = Y_i - Y_{i-1}$, $\partial X_i^{'} = X_i - X_{i-1}$ iff $X_i \succ X_{i-1}$ and zero otherwise; $\partial X_i^{''} = X_i - X_{i-1}$ iff $X_i \prec X_{i-1}$ and zero otherwise; X_0 is the initial value of X and Y_0 is the initial value of Y. The value of Y at any time‘t’ is given by:

$$Y_t = Y_0 + \sum_{t=1}^{t} \partial Y_i \qquad (2)$$

For i = 1, 2, 3, …………, t, t+1, …..T; where T is the total number of observations beyond the initial value. The difference between the current and the initial value of Y is the sum of period to period changes that have happened, such that:

$$Y_t - Y_0 = \sum_{i=1}^{t} \partial Y_i \qquad (3)$$

Inserting the first equation into the third equation and simplifying will yield:

$$\left.\begin{aligned} Y_t - Y_0 &= \sum_{i=1}^{t} [\varphi_0 + \varphi_1 \partial X_i^{'} + \varphi_2 \partial X_i^{''}] \\ &= \varphi_0 t + \varphi_1 (\sum \partial X_i^{'}) + \varphi_2 (\sum \partial X_i^{''}) \end{aligned}\right\} \qquad (4)$$

Let Y_i^*, R_t^* and D_t^* be $Y_t - Y_0$, $\sum \partial X_i^{'}$ and $\sum \partial X_i^{''}$ respectively such that:

$$Y_i^* = \varphi_0 t + \varphi_1 R_t^* + \varphi_2 D_t^* \qquad (5)$$

Where R_t^* is the sum of all period to period increases in X and D_t^* is the sum of all period to period decreases in X and φ_0 a trend coefficient. Variables R_t^* and D_t^* are always positive and negative respectively. The non-reversible condition will hold only if $\varphi_1 \neq \varphi_2$. This model will thus be termed non-reversible model.

This model however seeks to find the contributory impact of the increases and decreases in the independent variables, which in our case are the maize prices, gdp (proxy for income), prices of close substitutes (wheat). Our modified model is presented as follows:

$$\partial Y_i = \varphi_0 + \varphi_1 \partial X_{1i}^{'} + \varphi_2 \partial X_{1i}^{''} + \varphi_3 \partial X_{2i}^{'} + \varphi_4 \partial X_{2i}^{''} + ... + \varphi_n \partial X_{(n-1)i}^{'} + \varphi_{n+1} \partial X_{(n-1)i}^{''} \quad (6)$$

This can also be re-written as equation (5) in the following:

$$Y_i^* = \varphi_0 t + \varphi_1 R_{x_1,t}^* + \varphi_2 D_{x_1,t}^* + \varphi_3 R_{x_2,t}^* + \varphi_4 D_{x_2,t}^* + ... + \varphi_n R_{x_{n-1},t}^* + \varphi_{n+1} D_{x_{n-1},t}^* \quad (7)$$

For i = 1, 2, 3, ………., t; where $R_{x_1,t}^*$ represents the incremental changes in the first explanatory variable at period t**,** up to variable $X_{n-1,t}$, $D_{x_1,t}^*$ up to $D_{x_{n-1},t}^*$ are all decrement changes in explanatory variables. The reversibility conditions will now be $\varphi_1 \neq \varphi_2$, $\varphi_3 \neq \varphi_4$, **…….,** $\varphi_n \neq \varphi_{n+1}$ depending on the number of explanatory variables.

Following the non-reversibility model above, using Sim's (1980) VAR presentation, with four variables, we write the VAR model as:

$$BX_t = \Gamma_0 + \Gamma_1 X_{t\text{-}1} + \varepsilon_t \quad (8)$$

Solving for X_t yields

$$\left.\begin{aligned} B^{-1}BX_t &= B^{-1}\Gamma_0 + B^{-1}\Gamma_1 X_{t-1} + B^{-1}\varepsilon_t \\ X_t &= B^{-1}\Gamma_0 + B^{-1}\Gamma_1 X_{t-1} + B^{-1}\varepsilon_t \end{aligned}\right\} \quad (9)$$

For simplicity, assume the following model,

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + ... + A_p y_{t-p} + \varepsilon_t \quad (10)$$

Where y_t is an (nx1) vector containing the variables included in the VAR model of this study, c is an (nx1) vector of constant terms (intercepts), A_i is a (nxn) vector of matrices coefficients and ε_t is an (nx1) vector of stochastic error terms.

3. Empirical Results

The nature of the data used in the study is given in table 1 below. The residuals from GDP, wheat prices and maize prices are found to be not normality distributed since the null hypotheses of normality are rejected at 5 percent level of significance. This is shown by their low probability values of 0.0014, 0.015 and 0.0034 for the respective variables. These non-normality of residuals from these variables could be attributed some outliers and even possibly the presence of structural breaks.

Table 1. Descriptive statistics

Variable →	***M_CONS***	***GDP***	***M_PRICE***	***W_PRICE***
Mean	6606.791	732034.9	630.7960	1154.937
Median	6425.000	331980.0	464.0000	648.4200
Maximum	8933.000	3138980.	2266.780	4522.340
Minimum	4824.000	12791.00	37.68000	6.790000
Std. Dev.	1093.316	890786.8	615.0467	1293.485
Skewness	0.598483	1.316220	1.075703	1.252121
Kurtosis	2.691991	3.606987	3.094275	3.252158
Jarque-Bera	2.736944	13.07588	8.308733	11.34988
Probability	0.254496	0.001447	0.015696	0.003431
Sum Sq. Dev.	50204277	3.33E+13	15887862	70270394
Observations	43	43	43	43

Source: Author's calculations

The detection of normality/non-normality in the residuals from the variables used in this study compels us to establish the stationarity tests, although the non-reversibility procedure does not require that. This is performed to determine such prior to estimation of the SVAR model and to avoid the likelihood of false conclusions resulting from spurious regression. It is therefore imperative to establish the order of integration of the variables applied in this study. As mentioned above about the structural nature of the variables: maize demand (Cons), maize prices (Mpr), gross domestic prices (GDP) and wheat prices (Wpr), the study employs the Zivot-Andrews (Zivot & Andrews, 1992) unit root test of which the results are presented in table 2 below.

Table 2. Z-A and ADF unit root test results

	Z-A Test			ADF Test			
Variables	***Z-A Stat C only***	***Z-A Stat T***	***Z-A Stat C & T***	***ADF Stat (none)***	***ADF Stat C only***	***C & T***	***Overall decision***
$CONS_t$	-4.132[1]^A	-4.132[1]^A	-4.52[1]^A	1.6908[0]^A	-0.3022[0]^A	-2.686[1]^A	NS
MPR_t	-0.860[4]^R	-2.008[4]^A	-2.02[4]^A	5.2531[4]^R	3.4445[4]^R	0.9029[9]^A	NS^{Z-A}
WPR_t	-2.24[4]^A	-3.80[4]^A	-3.75[4]^A	4.2944[4]^R	3.2770[4]^R	-0.157[2]^A	NS^{Z-A}
GDP_t	2.4513[0]^A	-0.94[0]^A	-0.92[0]^A	25.9644[0]^R	19.4293[0]^R	7.4279[0]^R	NS^{Z-A}

Notes:

1) A = Accept null, R = reject null, NS = Non-Stationary in both tests, NS^{Z-A} = Non-stationary using Z-A test;
2) The [ ] contains the lag length selected using the SIC;
3) The significance level chosen is 5%.

The lag length is selected using the SIC imbedded with the e-views software package. For statistical analysis of this paper, the ADF (Dickey & Fuller, 1979) test of unit root cannot be relied upon due to the span of the series used. This is attributable to some major economic happenings that could have occurred during the period under consideration that could have generated potential non-stationaries. Such non-stationaries can have some implication for over or under estimation of the results, hence the Z-A test. The overall results indicate that the variables are integrated of order one.

3.1. Estimation of the Non-Reversible Equation

Given the non-reversibility condition(s) as stated in 3 above, equation (7) was estimated and the results are presented in table 3 below. The explanatory variable is $C_t - C_0$, where C_t is the value of maize consumption at period t and C_0 is maize consumption at initial period, that is the starting period. This dependent variable ($C_t - C_0$) represents Y_t^* in (7).

Table 3. Irreversible function estimation results

Variable	*Coefficient*	*Std. Error*	*t-Statistic*
R_{MPRICE}	-0.127231	0.048946	-2.599415
D_{MPRICE}	0.192622	0.787199	0.244693
R_{WPRICE}	0.033619	0.449600	0.074776
D_{WPRICE}	0.138705	0.466008	0.297645
R_{GDP}	0.001091	0.000617	1.768233
C	685.1639	127.9463	5.355091
R-sqrd = 0.83807		***Adj. R-sqrd = 0.81557***	

The results above indicate that about 84% of Y_t^* is explained by both increases and decreases in the maize price, wheat prices and only increases in GDP. Decreases in GDP were not observed hence the exclusion of D_GDP. The maize price bears a negative sign, indicating that when prices increase, consumption of maize falls by about 12 percent, while decreases in maize price will increases maize consumption by about 20 percent. The first non-reversibility condition is that $\varphi_1 \neq \varphi_2$ ($-0.127231 \neq 0.192622$) and the second condition being $\varphi_3 \neq \varphi_4$ ($0.033619 \neq 0.138705$) and these two conditions hold and suggest that maize demand is indeed irreversible in South Africa. It is however, noted that since decreases in GDP were not observed, this variable was excluded in the non-reversibility equation since we could not attain $\varphi_5 \neq \varphi_6$.

3.2. Impulse Responses from Svar Model

In an attempt to establish the structural nature of the maize product in South Africa, it is imperative to revisit the VAR model that incorporates the structural changes. This however requires that the SVAR models be identified. Identification of such models assists in avoiding the problems in dynamic simultaneous equation models and this requirement is attributable to Sims (1980) and Gottschalk (2001). One distinctive feature of the SVAR modes is that it treats all variables as endogenous. This type of method helps us to obtain the structural innovations, that is, coefficients that have the economic interpretation from the reduced innovations (Ravnik & Zilic, 2011). The SVAR model takes the form of the AB model as postulated by Lutkepohl (2005) with the following appearance: $Au_i = Be_i$, so that it becomes possible to construct matrices A and B. The A matrix obtained after imposing the restrictions on the VAR model was given as:

$$A = \begin{bmatrix} . & . & . & . \\ a_{21} & . & . & . \\ a_{31} & a_{32} & . & . \\ a_{41} & a_{42} & a_{43} & . \end{bmatrix} = \begin{bmatrix} . & . & . & . \\ 0.8418 & . & . & . \\ -0.0637 & 0.2343 & . & . \\ -0.1092 & -0.0714 & -0.0043 & . \end{bmatrix}$$

and the B matrix as:

$$B = \begin{bmatrix} b_{11} & . & . & . \\ . & b_{22} & . & . \\ . & . & b_{33} & . \\ . & . & . & b_{44} \end{bmatrix} = \begin{bmatrix} 0.052290 & . & . & . \\ . & 0.178684 & . & . \\ . & . & 0.165787 & . \\ . & . & . & 0.032264 \end{bmatrix}$$

This results coupled with the identification of the VAR model suggest that the model was just-identified and hence the innovations in the Choleski decomposition have a direct economic interpretation (Enders, 2010). The Choleski decomposition requires that $a_{12} = a_{13} = a_{14} = a_{23} = a_{24} = a_{34} = 0$, that is all the elements above the principal diagonal to be zero. At this stage, it is imperative to present the structural innovations in order to find the effect of structural shocks on maize consumption in South Africa. The results of structural innovations are presented in figure 3 below:

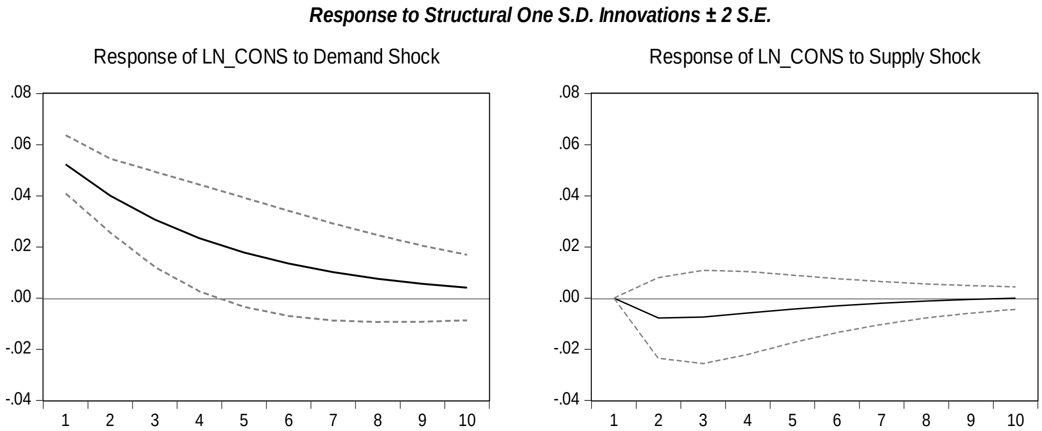

Figure 3. Structural Impulse response functions

The results indicate that maize consumption responds negatively to demand shocks, while it responds negatively to supply shocks in periods 2 and 3, otherwise positive for periods 4 through 10. In the case of demand shocks, demand tends to responds negatively throughout the periods. Prices changes as well cannot ignored when addressing the demand and consumption of maize in the economy. Any of the changes in the variables will bring some responses in maize consumptions.

4. Conclusion

The study employed a time series annual seasonal data for South Africa spanning the periods 1970/71 to 2012/13. In order to test the non-reversibility of the maize function, the data was transformed into changes from the previous points as per the T-Q and the W theorems. The data descriptive statistics revealed that the residuals from GDP, wheat prices and maize prices are not normality distributed since the null hypotheses of normality are rejected at 5 percent level of significance. These non-normality could be as a result of some major outliers in the series and the possibly of the presence of structural breaks. The unit root test was performed as a precautionary measure to establish the order of integration, using both the Z-A unit root test as well as the ADF unit root test. The results from these tests suggested that maize consumption, maize prices, wheat prices and GDP were all integrated of order one.

The results indicate that when maize prices increase by 1 percent, consumption of maize falls by approximately 12 percent, while on other hand decreases in maize price drive consumption up by nearly 20 percent in the short-run. It is also noted that, despite almost all non-reversibility conditions being met, decreases in income are not observed due to the violation of the conditions and hence the variable being dropped from the system. The structural VAR on the other hand, which assumes that innovations are proliferated in the maize demand, maize prices, wheat prices and income indicate the VAR is just –identified. This enabled us to estimate the SVAR and test for structural shocks using innovation accounting practices (IRF[1]), which produced two significant demand and supply shocks. These results complement those obtained from the Houck procedure and suggest that maize consumption in South Africa is significantly affected by structural shocks from maize prices and wheat prices.

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The Endogeneity of Business Cycle Synchronisation in SADC: A GMM Approach

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Abstract: Studies often conclude that in SADC would be disastrous and not optimal for all member countries. This is because of the observed low, and even negative correlation amongst member countries. However, Frankel and Rose (1998) demonstrate that the degree of synchronisation is not irrevocably fixed and is endogenous to other factors. Hence, this study is set out to investigate factors influencing business cycle synchronisation in the SADC region. More precisely, we use a generalised method of moments (GMM) to investigate the influence of trade integration, financial integration, fiscal policy convergence, monetary policy similarity and oil prices (a proxy for global common shocks) on the degree of business cycle synchronisation. To conduct our analysis, we data covering the period of 1980-2014, we use bilateral data due to unavailability of regional aggragates. We find trade, fiscal policy convergence and monetary policy similarity to have a sanguine impact on the degree of synchronisation. Moreover, owing to their procyclical behavior, financial flows lead to diverging business cycles. In addition, we find oil prices to exert a negative impact on business cycle comovement in the SADC region. Our results have far-reaching policy implications for the proposed SADC monetary union- by stimulating trade, ensuring coherence in macroeconomic policies SADC could move closer to becoming an optimal currency area.

Keywords: SADC monetary union; financial integration; fiscal policy convergence; monetary policy

JEL Classification: E00

1. Introduction

Region-wide fixed exchange rate regime, or monetary union entails a loss monetary policy tools to deal with economic disturbances at a country-level. Therefore, for countries whose business cycles are significantly driven by idiosyncratic factors, using a common monetary policy or establishing a monetary union will be costly and not optimal for all member countries. Hence, to alleviate costs associated with the loss of monetary policy tools, the theory of optimal currency areas (OCA), amongst

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other things, put business cycle synchronicity as a necessary requirement. As a consequence, in a monetary union environment business cycle synchronisation has been extensively studied. In addition, business cycle synchronicity has been applied as an instrument to gauge the suitability of a monetary union in the Euro Area, East Asia, Eastern and Western parts of Africa, and most importantly, in Southern Africa.

Relying on historical data, enormous amount of studies suggests that adoption of a common monetary policy in SADC would disastrous, and would lead to macroeconomic instabilities across the region. This is because historical data uncover insufficient degree of business cycle comovement in SADC, and alternative adjustment mechanisms suggested by the OCA such as labour mobility, nominal flexibilities are absent.

Drawing from the famous Lucas critique, Frankel & Rose (1998) critique the view that business cycle synchronization is a precondition for adopting a common monetary policy. They argue that historical data may be misleading and business cycle synchronicity is not irrevocably fixed, and is not exogenous. If this thesis holds, business cycle synchronisation could be an *ex post* rather than an *ex ante* phenomena. This notion is owing to the view that introducing a single currency reduces transaction costs, and exchange rate uncertainty and therefore, stimulate trade which in turn reinforces business cycle comovement (Gouveia & Correia, 2013). Consistent with this view, Rose (2000) demonstrate that countries sharing a single currency tend to trade more with each other, and are more synchronized vis-à-vis countries not sharing the same currency. Likewise, Barro & Tenreyro (2007) reveals that adopting a single currency tend to fuel trade. Moreover, Rose & Van Wincoop (2001) argue that indeed, using a single currency tend to boost trade; therefore, international currencies (*multiple currencies*) appear to be a significant impediment for trade.

As mentioned earlier, that the literature on the degree of business cycle synchronisation in SADC often concludes that based on weaker business cycle alignment common monetary policy in SADC would not be optimal[1]. However, neither of these studies attempts to uncover factors which could explain the underlying levels of synchronisation, nor they suggest solutions to the observed low levels of synchronisation. Therefore, in this study we set out to investigate factors influencing business cycle comovement in SADC. Identification of factors explaining comovement in SADC is essential for a number of reasons. Firstly, it equip policy makers with crucial knowledge to develop structural policies that will improve efficiency, and allow the application of a common monetary policy. Secondly, if business cycles are driven by peripheral factors such as trade, internal policies intended to stabilize the economy would have negligible impact on output

[1] See (Kabundi & Loots, 2007; Tipoy, 2015, Zerihun & Breitenbach, 2014; Nzimande & Ngalawa, 2016)

growth, thus necessitating for economic policy coordination. Therefore, deeper knowledge about factors through which business cycles are transmitted is warranted, and has far-reaching policy implications. Moreover, knowledge of the factors influencing business cycle comovement would assist SADC monetary union aspirants trying to determine the best timing to adopt a single currency, and whether such move would fast-track their convergence process (Vieira & Vieira, 2012).

This paper is organize as follows. The next section reviews the literature on factors explaining business cycle comovement. Section 3 describes data and empirical framework applied to conduct the analysis. Results and discussion are presented in section 4, whereas final section concludes and identifies scope for further research.

2. Literature Review

Why some countries are synchronized, and others are not? What could possible explain the observed low levels of business cycle synchronisation in SADC? The ability to answer these questions will contribute toward the development of structural policies that mitigate the adverse impact associated with the use of a single monetary policy. This section therefore, concisely reviews literature on the determinants of business cycle comovement.

A number of potential determinants of business cycle synchronisation, such as trade, currency union membership and industrial similarity, amongst others, have been identified[1]. However, industrial similarity and currency union membership are generally found not to be robust estimators of synchronisation, thus they are excluded from our analysis (Furceri & Karras, 2008; De Haan et al., 2008; Clark & Van Wincoop, 2001; Cerqueira & martins, 2009; Baxter & Kouparitsas, 2005 amongst others). In addition, required data to compute industrial similarity is hardly available in SADC, therefore, one extra reasons not exclude it from our analysis.

Trade is argued to play an integral role in explaining business cycle similarity; it ensures quick propagation of shocks across countries (Frankel & Rose, 1998; Faia, 2007; Gouveia & Correia, 2013; Barro & Tenreyro, 2007, amongst others). However, both empirical theoretical models and empirical evidence suggests an ambiguous link between trade and business cycle synchronicity.

There is a belief that trade intensification could results to asynchronous business cycles. Classical models of trade demonstrates that intensification of trade would result to specialisation as countries attempt to exploit comparative advantage (Krugman, 1993; Kenen, 1969). Since countries are specialized sector specific shocks will be translated to country-specific shocks, thus resulting to diverging

[1] See (Artis & Zhang, 1999).

business cycles. Consistent with this prediction, Crosby (2003) find that trade have adverse impact on business cycle synchronicity in Asia-Pacific countries.

On one hand, Backus *et al.*, (1993) argue that trade will result to strengthened business cycle comovement. A shock hitting a particular economy will be transmitted, through demand linkages, to its trading partners. Hence, countries which trade more with each other tend to be more synchronized that countries that trade less with each other (Di Giovanni & Levchenko, 2010). In line with this view, Frankel & Rose (1998) find that trade has a sanguine impact on business cycle synchronisation. In addition, they conclude that the theory of OCA is not exogenous, and business cycle synchronisation should not deter countries from establishing a monetary union. This is because, establishing a monetary union would result to a reduction in transaction costs etc. thus stimulating trade. Rose & Angel (2000) accord with this view, they demonstrate that countries using in a currency union tend to trade more with each other, than countries which are not in a union. There is a large strand of the literature showing a positive relationship between trade, and business cycle comovement, (Clark & Van Wincoop, 2001; Furceri & Karras, 2008, amongst others).

Contrast to both views about the impact of trade on business cycle synchronisation, Otto *et al.*, (2001) questions the importance of trade in explaining business cycle comovement. They argue that Australia trades more with Japan than with United States; yet, it business cycle is strongly correlated with that of United States vis-à-vis Japanese business cycle. This is consistent with Dellas (1986) he demonstrate that trade linkages plays little role in explaining business cycle comovement, and he argues that interdependencies are rather explained by common shocks.

The other channel which in the literature is argued to have positive impact on business cycle comovement is monetary policy[1]. Although number of studies found monetary policy similarity to have positive impact on business cycle synchronicity; its impact on business cycles is still unsettled. Otto et al., (2001) find that great volatility in interest rate differential has a negative impact on business cycle synchronicity. Whereas, Clark and Van Wincoop (1999) find that monetary policy similarity has no significant impact on business cycle comovement. Schiavo (2008) find that monetary policy similarity has an indirect impact on business cycle comovement. Thus, the endogeneity of business cycle synchronisation does not suggest that by joining a monetary union countries will become more synchronized, but rather, the prospective increase in trade and financial linkages induced by the use of a common currency will have a positive influence on business cycle comovement.

Following the establishment of the European Union, the impact of financial integration received enormous interest from both scholars, and policy makers around

[1] See (Frankel & Rose, 1998 for discussion).

the globe. However, regarding financial integration Southern Africa has been neglected as an area of study. Financial integration is expected to promptly increase in Southern Africa due to the envisaged economic integration, and the proposed introduction of Southern Africa single currency in 2018. Hence, understanding economic consequences of deeper financial integration is warranted.

Given that country-specific shocks can no longer be dealt with by maneuvering monetary policy tools, since monetary policy tools are dedicated to addressing union wide disturbances. Given the lack of independent monetary policy response, asymmetric disturbances may induce welfare loses, and threatens the stability of a monetary union, unless, risk sharing mechanisms are in place, and one of the mechanism through which risk are shared is financial integration.

Financial integration is integral for the functioning of a monetary union because it allows agents to exploit "risk sharing" mechanisms thus resulting to synchronisation of business cycles (Cerqueira & martins, 2009). For example, Balli *et al.*, (2011) argue that monetary policy in a monetary union may fail to deal with asymmetric disturbances, so financial integration permit consumers to borrow from countries experiencing booms, and therefore synchronizing cycles. Kose *et al*., (2003) also argue that stronger financial linkages could reinforce business cycle synchronisation through demand linkages. Similar conclusions are reached by Imbs (2001; 2006). Consistent with these studies, Jansen and Stockman (2004) demonstrate that financial integration results to stronger business cycle comovement across countries. Moreover, Kose *et al*., (2008a; 2008b) show that financial linkages stimulate business cycle synchronisation.

On the other hand risk sharing encourages industrial specialisation, thus resulting to asymmetric shocks which in turn result to asynchronous business cycle. This has been demonstrated, amongst others, by Kalemli-Ozcan (2003) and Obstfeld (1994). Moreover, Backus *et al*., (1992) argue that the behavior of financial flows is procyclical. For example, assume that there two countries in the world, X and Y, and X experiences a positive technological shocks; agents will pull their capital from country Y to country X where marginal product of capital and labour has increased. Therefore, the procyclicality behavior of financial flows will results to diverging business cycles. In line with these studies Garcia-Herrero and Ruiz (2008) show that intensified financial integration leads to asymmetric business cycles. Heathcote and Perri (2004) reach similar conclusions that financial integration leads to diverging business cycles.

Fiscal policy discipline or convergence is identified as another important channel through which business cycles are synchronized. However, a plethora of economists treat fiscal policy convergence with cynicism, because it has little or nothing to do with the traditional theory of optimal currency areas. In addition, there is no existing theory linking fiscal policy convergence with business cycle comovements (Darvas *et al.*, 2005). Despite the lack of theoretical connection between business cycle comovement and fiscal policy convergence, it is relatively easier to build an instinctive link between the two. Countries which are ill-disciplined in their fiscal policy conduct i.e. countries that run high budget deficits, generate individual fiscal policy shocks thus resulting to diverging business cycles. Thus, in envisaged, and or already established unions, fiscal policy should be counter-cyclical as opposed to procyclical (Gavin & Perrott, 1997; Brender & Drazen, 2004). Simply put, in the absence of idiosyncratic shocks which would otherwise lead to divergent business cycles, the use of fiscal policy would be irresponsible. Consistent with this, Fatás and Mihov (2003) argue that aggressive use of fiscal policy is associated with macroeconomic instabilities, and impede economic growth. Similarly, Badinger (2009) show that discretional use of fiscal policy results to significant and ample output volatility. Rodden and Wibbels (2010) accord with the view that fiscal policy should rather be counter-cyclical. In addition, fiscal policy in a monetary union should be centralized, and centralized fiscal policy provides insurance (in terms of fiscal transfers) against adverse shocks hitting a particular economy in a union[1]. Furthermore, Fatás and Mihov (2003) argue that fiscal policy restrictions would lower macroeconomic volatilities. However, on the other hand fiscal policy restrictions are argued to limit fiscal policy action when it is needed the most (i.e. in the presence of shocks which would otherwise lead to diverging business cycles). In addition, fiscal policy restrictions may exacerbate economic fluctuations since they disregard cyclical conditions (Levinson, 1998). For example, in the case of Europe they argue that rules will worsen recessions, since countries will be tempted to apply procyclical fiscal policy when cyclical downturns increase deficits towards the Stability and Growth Pact (SGP) cap (Lane, 2003 and Alt and Lowry, 1994).

3. Methodology and Data

3.1. Econometric Framework

Longitudinal data methods have become increasingly popular in the past few decades and are now the most used tools in contemporary econometrics, both in microeconomics and macroeconomics (Hsiao, 2005). The increasing popularity of panel data techniques is owing to a number of factors, predominantly because they allow practitioners to exploit two dimensions of the data: a cross-sectional dimension and a time series dimension (Hsiao, 2005).

Consider the following simple linear dynamic panel model:

$$y_{it} = y_{it-1} + X_{it}\beta + \mu_i + \epsilon_{it} \qquad (1)$$

[1] See (Spahn, 1997).

$$\epsilon_{it} = \mu_i + \varepsilon_{it} \quad (2)$$

Where $i = 1,2 \dots \dots, N$, $t = 1,2 \dots \dots, T$, X' is a $(1 \times K)$ vector of regressors, β is a $(K \times 1)$ vector of coefficients to be estimated, μ_i represents an individual fixed effects, capturing individual differences, andε_{it} denote individual error term. We assume $\mu_i$and $\varepsilon_{it}$to be $\mathrm{i.i.d.}$ with $(0, \sigma^2)$. Moreover, we assume that are exogenous to each other. Therefore,

$$E[\omega_{it}] = [\tau_{it}] = [\omega_{it}, \tau_{it}] = 0 \quad (3)$$

The introduction of the lagged endogenous variable introduces a *dynamic panel bias* because μ_i and y_{it-1} are correlated. Because y_{it} is a function of μ_i which is time-invariant, it must also be true that y_{it-1} is a function of μ_i. Therefore, one of the regressors is correlated with one component of the error term, thus giving rise to the problem of endogeneity.

Hence, application of the ordinary least squares (OLS) in equation (1) will yield inconsistent and upward biased estimates, because $E[y_{it-1}, \epsilon_{it}] > 0$, therefore, β_1 will be overestimated (Blundell & Bond, 2000). To tackle endogeneity bias the literature suggests two remedies which could be applied simultaneously or successively. First, one can eliminate time-invariant effect by through data transformation such as first differencing. Secondly, by searching for valid instruments of the lagged endogenous variable (Mairesse & Hall, 1996).

For simplicity we reduce equation one to only include one explanatory variable,

$$y_{it} = \beta_1 y_{it-1} + \epsilon_{it} \quad (4)$$

To remove the time-invariant component of the error term which is correlated with the explanatory variable, equation (4) is subtracted from equation (3);

$$y_{it-1} = \beta_1 y_{it-2} + \epsilon_{it-1} \quad (5)$$

Resulting to equation (5)

$$\Delta y_{it} = \beta_1 \Delta y_{it-1} + \Delta \varepsilon_{it} \quad (6)$$

Where $\Delta = (1 - L)$ is a first difference operator. In other words, we get the transformation by multiplying equation (2) by $I_N \otimes D$, where I_N is an identity matrix of dimension N snd D is a $T - 1) \times T$ matrix[1];

$$\begin{pmatrix} -1 & 1 & 0 & \dots & 0 & 0 \\ 0 & -1 & 1 & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & -1 & 0 \end{pmatrix} \quad (7)$$

[1] See Arellano (2003) for more discussion.

Although first differencing $(T-1)$ takes care of the individual time-invariant effect, its results to the loss of the degrees of freedom, since its drops T initial observations which could have severe ramification for an unbalanced panel (Griliches & Mairesse, 1998). The transformation, the first difference estimator is the OLS estimator of the equation (6) that is

$$\hat{\beta}=\left\{\sum_{i=1}^{N}(DX_i)'DX_i\right\}^{-1}\sum_{i=1}^{N}(DX_i)'Dy_i \qquad (8)$$

Owing to the assumption that $\tau_{it}\sim\text{i.i.d.}(0,\sigma_\tau^2)$, the first difference estimator is inconsistent since the transformation (i.e. the first differencing) prompts a $MA(1)$ process for the $\Delta\tau_{it}$. This issue calls for a generalised least squares (GLS) (see, Arellano, 2003). Moreover, as shown in Arellano (2003) the optimal GLS estimator is the within-Group estimator which takes the following form;

$$\hat{\beta}_{WG}=\left(\sum_{i=1}^{N}X_i'D'(DD')^{-1}DX_i\right)^{-1}\left(\sum_{i=1}^{N}X_i'D'(DD')^{-1}Dy_i\right) \qquad (9)$$

In line with Arellano (2003) Q matrix is defined as the "*deviations-from-time-means*" because it alters y_{it} series into deviations from time averages $\bar{y_i}=Qy_i$, whose elements are $\bar{y}_{it}=y_{it}-\bar{y}_i$. Q Matrix is shown to be:

$$Q\equiv D'(DD')^{-1}D \qquad (10)$$

Again, the within group estimator successfully get rid of the individual fixed effect, however, it fails to fix the dynamic panel bias. Therefore, yields inconsistent estimates (Nickell, 1981).

Given their failure, pooled OLS, the first difference estimator and within group estimator, to resolve the issue of dynamic panel bias, an alternative tool to deal with the challenge is warranted.

Instrumental variable estimators are amongst alternative models used to deal with the issue of dynamic panel bias (Anderson & Hsiao, 1981; 1982 amongst others). The instrumental variable approach is usually preferred over the maximum likelihood of Hsiao (2003), on the grounds that maximum likelihood (ML) requires that assumptions about initial conditions be made, and that they must be correctly specified, otherwise, ML estimator would be inconsistent. Although the estimators of Anderson and Hsiao successfully identify the model, they are not necessarily efficient because they do not exploit all instruments available[1].

[1] See for a lengthy discussion.

The panel data generalised method of moments[1] (GMM) circumvent most, if not all issues faced by other estimators. Through exploitation of a set of meaningful set of instruments, for each instrument, GMM permits the use of all available instruments. Arellano and Bond (1991) suggest the use of all available lags each period in time as instruments for first-differenced lagged endogenous variable in equation (5)[2]. The Arellano & Bond (1991) estimator is known as the difference GMM estimator. The Arellano &Bond (1991) first difference estimator is given by:

$$\hat{\beta}_{GMM\ diff} = \left((\Delta y'_{-1} Z_{\mathrm{d}})W_N(Z'_d \Delta y_{-1})^{-1}(\Delta y_{-1} Z_d)W_N(Z'_d \Delta y\right) \qquad (11)$$

Where $\Delta y_i = (\Delta y_{i3}, \Delta y_{i4}, \dots, \Delta y_{iT})'$, Δy_{-1} is vector which includes the first lag of Δy_i, $Z'\Delta y = \sum_{i=1}^{N} Z_{di}, y_i$, W_N is an optimal weighting matrix and Z_d is an instrument matrix for i^{th}individual which has $T-2$ rows with non-negative element and $(T-2)(T-1)/2$ columns. The difference GMM estimator of Arellano & Bond (1991) is consistent for $T \to \infty$, $N \to \infty$ and also for fixed T.

Although, the first difference GMM estimator performs better than other panel techniques[3], it is however not without hitches. More precisely, when the lags of dependent variable are weakly correlated with dependent first differences in the following period, first difference GMM (FDGMM) is argued to suffer from finite sample bias (Blundell & Bond, 1998).

The drawbacks of the Arellano & Bond (1991) estimator gave birth to the systems GMM of Blundell & Bond (1998). The systems GMM formulate supplementary orthogonality conditions that make more valid instruments accessible and efficiency gains. In addition to the use of lagged levels of y_{it} as instruments for the first differences equations, system GMM estimator (SGMM) uses the lagged first-difference Δy_{it-1} of y_{it} as instruments for equation (1) in levels. Therefore, the resulting SGMM estimator is given:

$$\hat{\beta}_{iGMM\ s} = \left(q'_{-1} Z_{sW_N Z'_s q_{-1}}\right)^{-1}(q'_{-1} Z_s W_N Z_s q_i) \qquad (12)$$

Where $q_i = (\Delta y'_i, y'_i)$ and Z_s is full instrument matrix. The SGMM is proved to be more efficient relative to FDGMM estimator, especially as $\beta \to 1$.

In light of the issues associated with dynamic panel data and other dynamic panel data estimators such as FD and the within group, this study employs systems GMM to estimate factors influencing business cycle comovement in SADC. A plethora of studies have used similar equation to estimate factors influencing business cycle synchronisation and thus variables employed in the study are adopted from various

[1] Initially developed by Hansen (1982); Hansen and Singleton (1982).
[2] Holtz-Eakin, Newey & Rosen (1988) also suggest the same thing.
[3] See (Bond, Hoeffler & Temple, 2001; Blundell & Bond, 1998).

studies (Lee & Azali, 2010; Cerqueira & Martins, 2009; Clark & Wincoop, 2001; Darvas et al., 2005 amongst others).

$$Y_{ikt,t} = \alpha_0 + \alpha_1 Y_{ik,t-1} + \alpha_3 TI_{ik,t} + \alpha_4 FI_{ik,t} + \alpha_5 FP_{ik,t} + \alpha_6 MPS_{ik,t} + \alpha_7 OP_{ik,t} + e_{ik,t} \quad (13)$$

Where $Y_{it,t}$ is business cycle correlation index between country i and k, $TI_{ik,t}$ denotes trade intensity, $FI_{ik,t}$ is the degree of financial integration, $FP_{ik,t}$ represents fiscal policy convergence, $MPS_{ik,t}$ is monetary policy similarity, $OP_{ik,t}$ is are oil prices which represent exogenous common shocks, and $e_{ik,t}$ is the error term.

3.2. Data Sources

We use a panel data covering the period of 1980-2014 which is collected from various sources. Nominal oil prices are collected from IMF world economic indicators, and converted into real oil prices using world GDP deflator collected from IMF world economic indicators database. Data on financial flows, inflation rates, and government deficit/surplus were collected from World Development Indicators, and data on bilateral trade is collected from CEPPII database.

3.3. Construction of Variables

Real Oil Prices: in line with existing studies, we use real oil prices as measure for global exogenous shocks[1].

Business cycle synchronisation index:

To construct business cycle index we follow Kalemli-Ozcan (2009) and Gionnone et al., (2009), they construct the index of business cycle comovement as negative absolute differences in real GDP between country i and j. Thus, we have a total of $N(N-1)/2$, bilateral correlations.

$$BS_{ijt} = -\left|(lnGDP_{it} - lnGDP_{it-1}) - \left(lnGDP_{jt} - lnGDP_{jt-1}\right)\right| \quad (14)$$

Fiscal Policy Convergence:

$$FC_{ijt} = \left|\frac{Govtspend_{it}}{GDP_{it}} - \frac{Govtspend_{jt}}{GDP_{jt}}\right| \quad (15)$$

[1] See (Moneta & Ruffer, 2009; Kutu & Ngalawa, 2016, amongst others)

To measure fiscal policy convergence, we follow Darvas *et al*., (2005), they measure convergence as absolute differences in government budget deficit/surplus between the two countries in question as a share of GDP.

Monetary Policy Similarity:

$$MPS_{ijt} = \left|\pi_{it} - \pi_{jt}\right| \quad (16)$$

Monetary policy similarity is measured as absolute differences in inflation rate between country i and j.

Financial Integration:

- *De facto financial Integration*:

$$FI_{jkt} = \left[\left(\frac{CF_{jt}}{GDP_{jt}}\right) + \left(\frac{CF_{kt}}{GDP_{kt}}\right)\right] \quad (18)$$

De facto financial integration is measured as a sum of financial flows (outflows and inflows) between the countries of interest weighted by the sum of their GDP's.

Trade Integration:

$$Trade_{Intense} = \frac{\sum\left(\left(X_{ijt} + M_{ijt}\right) + \left(X_{jit} + M_{jit}\right)\right)}{\sum\left(Y_{it} + Y_{jt}\right)} \quad (18)$$

Trade intensity is measured as a sum of exports and imports between the two countries in consideration weighted by the sum of their GDP's.

4. Results and Discussion

To address potential problems of endogeneity, we employ the Blundell and Bond (1998) generalized method of moments. This section therefore presents result from GMM regressions.

In line with Frankel and Rose (1998), Clark and Van Wincoop (2001), Imbs (2006) and Cerqueira and Martins (2009) our results suggest that trade countries with greater bilateral trade relations tend to have greater synchronisation of their business cycles. This implies that removal of trade restrictions will result to higher degree of synchronisation since increased levels of trade will permit easy transmission of demand shocks across countries. Contrast to Kose et al., (2003) who find that the positive link between trade and business cycle comovement is limited only to industrial countries, we demonstrate that the relationship holds even in developing countries[1].

Table 1. Systems GMM: Factors Influencing Business Cycle Synchronisation

Lagged Dependent Var.	0.367***	0.324***	0.381***	0.377***	0.341***
	(0.013)	(0.013)	(0.011)	(0.009)	(0.027)
Trade intensity	0.224***	0.219***	0.160***	0.102*	0.079**
	(0.032)	(0.348)	(0.056)	(0.053)	(0.0 63)
De facto financial integration		-0.383***	-0.291***	-0.668***	-0.753***
		(0.058)	(0.071)	(0.135)	(0.098)
Mon. pol. Similarity			0.016	0.049***	0.055**
			(0.023)	(0.016)	(0.023)
Fisc. pol convergence				0.624***	0.455**
				(0.145)	(0.185)
Oil Prices					-0,506***
					(0.212)
Arellano-Bond test for AR(1)	-4.98	-4.38	-4.15	-4.32	-4.24
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Arellano-Bond test for AR(2)	1.26	1.38	1.56	1.88	1.60
	[0.206]	[0.168]	[0.118]	[0.601]	[0.109]
Hansen Test	65.83	59.98	54.95	56.54	54.76
	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]

*, **, *** represents 1%, 5% & 10% levels of significance

In round brackets are standard errors, and in square brackets are p-values for corresponding tests

Our findings imply that SADC must strive to strengthen trade ties amongst member countries. Indeed, initiatives to reinforce trade relations in SADC are place. For example, SADC free trade area was established in 2000. However, countries like Democratic Republic of Congo and Seychelles are not part of the free trade area. If countries which remain outside the free trade area could join, the scope of intra-SADC trade could be expanded and thus reinforcing business cycle comovement.

[1] See also (Calderon et al., 2007).

In addition, our results have far reaching implications for the proposed SADC monetary union. As argued by Frankel and Rose (1998) and Shin and Wang (2003) if trade exerts positive influence on business cycle comovement, then even if a country that is not suitable *ex ante* to join a monetary union, it can be justified *ex post* due to the resulting business cycle coherence.

Contrary to Imbs (2004) and Kose *et al.*, (2003) who find that financial integrated countries tend to be highly synchronized. Our findings suggest that financial integration results to diverging business cycles in SADC. This is in line with the predictions of risk sharing theory, which suggests that financial integration results to higher production specialisation; and therefore, induce industry-specific shocks which translates to country-specific shocks thus asymmetric business cycles[1] (In addition, we argue that the behavior of financial flow is procyclical, such that agents tend to pull their investment from countries experiencing downturns, to countries experiencing booms. Simply put, better performing economies tend to attract more financial inflows; therefore, resulting to decoupling business cycles (Backus et al., 1992).

Contrary to Moneta and Ruffer (2009) we find that real oil prices have a decoupling effect on business cycles across the region. Simply put, our findings suggest that oil prices shocks lead to asynchronous business cycles. We argue that the desynchronizing effect of oil prices can be attributed to the fact that some countries in the SADC region are net oil exporters, and others are net oil importers. Real oil price shocks have different impact on business cycles across countries, depending on whether a country is a net oil exporter, or net oil importer. Indeed, studies examining the relationship between oil prices, and economic activity suggests that the response differs depending on whether a country imports or exports oil[2]. In addition, based on this finding, we argue that the view that global common shocks results to symmetric business cycle may not necessarily be the case. Common shocks will have coupling impact, if and only if, economies share a common economic structures.

Our findings suggest that monetary policy similarity has a positive and statistically significant impact on business cycle comovement. Our results are consistent with existing literature (see Frankel and Rose, 1998 and Otto *et al*., 2001 amongst others). These findings have far reaching policy implications for SADC region. They suggest that monetary policy coordination

Although there are no established theoretical linkages between business cycle comovement, and fiscal convergence, empirical studies have suggested a positive link between the two variables (Artis *et al.*, 2008). Indeed, our results suggest that

[1] See (Kalemli-Ozcan et al., 2001; Kalemli-Ozcan et al., 2004; Cerqueira & Martins, 2009).

[2] See (Jimenez-Rodriguez & Sanchez, 2005; Nzimande & Msomi, 2016; Hamilton, 1983; Cunado & de Gracia, 2005; Lardic & Mignon, 2008).

there is a positive association between fiscal policy convergence and business cycle synchronisation in SADC. These findings are consistent with those of Darvas *et al.*, (2005) and Artis *et al.*, (2008). This finding is in line with the view that in a monetary union fiscal policy must be countercyclical, rather than being 'procyclical' (see Fatás and Mihov, 2004). In addition, Carmignani and Laurenceson (2013) argue that coordination of fiscal policies could result to synchronized business cycles. Therefore, we suggest that fiscal policy restrictions be imposed across SADC member countries, and policies must be coordinated. Overall, our findings show that the SADC convergence criteria should give rise to further coupling effect because of convergent fiscal policies (Anoruo & Ahmad, 2013).

5. Concluding Remarks

We assessed the relationship between trade intensity, financial integration, fiscal policy convergence, monetary policy similarity, oil prices and business cycle synchronisation in SADC member countries, over the period of 1994-2014. In line with Frankel and Rose (1998) we confirm that business cycle comovement is endogenous, and thus the observed lower levels of synchronisation in SADC are not irrevocably fixed. Contrast to Krugman (1993) we find that intensifying trade results to more synchronous business cycles. In addition, all other variables, with exception of oil prices, and financial integration have positive impact on business cycle synchronisation. The adverse effect of financial integration on business cycles is in line with the predictions of 'risk sharing' theory. The risk sharing theory suggests that financial integration will induce industrial specialisation across the regions or countries and thus leading to asymmetric shocks- thus decoupling business cycle. Furthermore, the negative influence of financial integration on business cycle synchronisation could be explained by the procyclical behavior of financial movements. With regards to oil prices, we argue that their decoupling effect could be explained by the fact that some countries in the region are net oil exporters while others are net oil importers; thus oil price shocks have different impact- depending on whether a country is a net importer, or exporter of oil. Furthermore, we show that fiscal policy convergence and monetary policy similarity have a business impact on business cycle comovement. Thus, the SADC convergence criteria should give rise to increased synchronisation due to convergent fiscal policies, and similar monetary policies.

Overall, we conclude that indeed business cycle synchronisation is not irrevocably fixed, and is endogenous (De Grauwe and Mongelli, 2005). Thus, consistent with Flandreau and Maurel (2005) we recommend a fast establishment of SADC monetary union relatively independent of the attained degree of business cycle synchronicity. In addition, number of studies have shown that monetary union could be established even if countries are not synchronized *ex ante* they can get more synchronized *ex post*[1].

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Econometric Analysis of the Effects of Aggregate Expenditure on Job Growth in the Private Sector: The South African Case

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Abstract: The private sector contributes to job creation either directly by creating new positions for job seekers or indirectly by increasing growth that results in job creation for unemployed people. This study employed an Autoregressive Distributed Lag (ARDL) model to analyse the long and short run effects of aggregate expenditure on job creation in the private sector in South Africa. The findings indicated that there is a long run relationship between aggregate expenditure and job creation in the private sector. Investment spending and net exports are the aggregate expenditure components that create long-term jobs, whereas consumer consumption and government spending lead to possible long run job destruction. The Error Correction Model (ECM) results revealed that consumption and investment spending create jobs in the short run, while the Granger-causality test suggested that a bi-directional causal relationship exists between consumption, investment spending and employment in the private sector. The study concluded that the negative effect of consumption on private employment might be due to the consumption of imported goods and services. Thus, the employment situation in South Africa could be improved if more focus is placed on consumption of domestic products.

Keywords: Aggregate spending; ARDL analysis; employment; private sector; South Africa

JEL Classification: C5; E2

1. Introduction

The South African rate of unemployment has increased dramatically before, and even after, the election of the democratic government in 1994 (Altman, 2003). Unemployment creates an imbalance in income distribution, leading to income inequality and high poverty levels (Triegaardt, 2006). Consequently, people receiving a monthly income are expected to support those who cannot afford to pay

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for their daily expenses. This is done directly in the form of donations and social support or, indirectly, through government policies, such as the tax increases and government grants **(**Atkinson & Liem, 1986; Krueger & Meyer, 2002). In South Africa, social grants are a reality and more than 40 percent of South African households are dependent upon these grants (Schussler, 2013). The role of the private sector (which consists of business enterprises) as regards job creation has been a subject of discussion; different conclusions were reached in the past. Some studies have proven that the private sector does create jobs, while others demonstrated the opposite. In other words, the private sector both creates and destroys jobs (Birch, 1987; Neumark et al*.*, 2011; Rosenberg, 2011; StatSA, 2016).

During the third quarter of 2016, employment increased in some sectors of the South African economy, while it declined in others. For instance, in the mining, manufacturing and financial sectors, it declined by 6.5 percent, 1.4 percent and 0.05 percent respectively. Notwithstanding, employment has increased by 1.3 percent in construction and 1.9 percent in the private sector (StatsSA, 2016). Despite the debate regarding the role of the private sector in job creation and the volatility that characterises employment in the private sector, this sector is considered to be one of the key areas that creates direct jobs (Dilger, 2017; IDC, 2016). In the South African context, this sector is an important economic one that contributes to GDP growth and to job creation (BER, 2016). Besides the direct contribution of the private sector to job creation, it impacts on productivity and job creation in collaboration with the public sector through knowledge diffusion and innovations (Kox & Rubalcaba, 2007). The private sector is therefore considered the engine that leads market success or failure (Cunningham, 2011). Therefore, spending on the private sector through consumer consumption, government spending, investment and exports are ways to boost and support job creation (Cray, 2011).

This paper aims to present the findings of analysis of the effects of aggregate expenditure on job creation in the private sector in South Africa. To achieve this, it attempts to answer the following questions: Do all four factors of aggregate expenditure (consumption, government, investment and net exports) contribute equally to job creation in the private sector? If not, which one of them is more effective than others? The following hypotheses are tested:

- Null hypothesis (H0): Components of aggregate expenditure do not affect employment in the private sector.
- Alternative hypothesis (H1): Components of aggregate expenditure do affect employment in the private sector.

2. Review of Literature

The concept that job creation could be stimulated through the private sector was generated by the work of Birch (1979), raising the issue of the way in which the US was losing jobs in the manufacturing sector to the benefit of employment in foreign countries. His aim was to distinguish whether new and small firms create more jobs than large and established firms or vice versa. The findings of that study were that between 1969 and 1976, more than two-thirds of net employment created resulted from new and small firms and that these firms were also hiring more youths than large firms were. Birch provided evidence of the role that small and medium enterprises play in the US economy regarding employment creation. Therefore, based on these findings, small firms deserve special attention. In the same regard, the International Finance Corporation (IFC, 2013) asserted that job creation in the private sector remains indispensable.

Globally, most jobs are created by the private sector; and in particular, more than 90 percent of the total number of jobs in developing countries are created by it (ILO, 2014). Consequently, countries with high rates of unemployment are those with weak job creation processes in the private sector. Increasing the amount of spending on private sector goods and services could be one of the strategies that might stimulate job creation, leading to poverty reduction (Toosi, 2002; Boushey & Ettlinger, 2011). The private sector, due to its ability to innovate, is a major influence on the GDP and job creation. A study conducted in 18 OECD countries, to determine how business enterprises affected employment between 2001 and 2011, found that approximately 75% of total employment emanated from employment generated by small business (OECD, 2015). This study also revealed that if small and medium businesses were supported through aggregate spending, even more jobs could be created. The study of Neumark *et al.* (2008) highlighted the important contribution made to the total employment and job creation endeavour by those small and medium enterprises. They stated that small businesses increase employment opportunities, especially in informal employment due to lower qualifications and skill requirements; just a few talented entrepreneurs are needed to develop employment opportunities for local communities.

The World Bank (2013) states that a higher rate of new jobs is created by small and medium firms due to their propensity for rapid growth, while large firms remain the ones with higher productivity and large numbers of employees. Therefore, increasing financial support for starting up and existing small businesses, without ignoring mature and large firms, allows both types of firms to access new technology and innovation and create more jobs. Although the public sector is a major employer in South Africa, the partnership between public and private sectors is a key factor in eradicating the high levels of unemployment (National Treasury, 2017). Wessels and Ellis (2012) argued that The National Development Plan (NDP) of 2011 aimed to eliminate unemployment and should focus on small and growing firms, as 90% of the needed jobs should be created through both types of firms. These new jobs would assist in increasing the total number of employment opportunities. The International Labour Conference (2015) confirmed this assumption, stating that small and medium businesses remain the engine of economic growth and job creation for all countries, especially in developing countries, regardless of incomes levels.

Inversely, Kerr *et al.* (2014) found that in South Africa more jobs were created by large firms, not by small ones. In support of Kerr *et al.*, Freund's (2011) study reported that small and medium businesses were not a final solution to the problem of unemployment because they function like a two-edged sword. On the one hand, the private sector (business enterprises) creates jobs, while on the other these firms also destroy jobs. The reason why some business enterprises do so resides in their inability to stay competitive for long periods. When these firms are outdone by the competition, their employees become jobless (Neumark et al., 2008). Therefore, what matters most regarding the labour force is not the number of employment opportunities created, but rather the net jobs created. In addition, young firms grow fast and create more jobs, yet they have a higher probability of failure compared to mature firms. This movement creates a disturbance in the labour force - destroying more jobs than creating new ones (Edmiston, 2007). For example, a study conducted in the US on how businesses create and destroy jobs, found that between 1976 and 2005, the annual rate of jobs created was 17.6% while the rate of jobs destroyed was 15.4%. As a result, the growth rate of employment was only 2.2% (Haltiwanger et al, 2010). The main findings emerging from the study were that the size of a firm affects its growth and capacity to create and maintain jobs. However, the theory that new firms could destroy jobs was refuted by Criscuolo *et al.* (2014). In a study undertaken on 18 OECD countries, including the US and Brazil, they found that unlike the more mature small businesses, new start-up firms play an indispensable role in creating jobs even during cycles where there is economic crisis. In this regard, the study by Federica and Bernt (2013) established that as a firm matures, its capacity to create jobs starts declining, until it reaches a negative effect on employment creation.

In contrast to this, the studies of Haltiwanger (2010) and Ayyagari *et al.* (2011) opposed the concept that supports the existence of a relationship between a firm's size, their growth and their ability to create jobs. The balance of success and failure of firms based on their sizes was found by the study conducted by Page and Söderbom (2015). Analysing the impact of a firm's size on job creation, the finding confirmed that more jobs are created in new and start-up firms; however, the likelihood of a firm's growth goes together with the probability of failing, leading to job destruction. Hence, more jobs are created and destroyed in small enterprises. The net jobs created by the small and medium enterprises decline as firms expand. Large and mature firms are characterised by higher salaries and high levels of job security. Consequently, the aggregate spending should be allocated to both types of firms.

Small firms are in need of investment support to be competitive and to grow, whilst large firms need to be supported in order to extend and safeguard existing jobs (Page & Söderbom, 2015). Consequently, the next section focuses on the analysis of the effect of total spending on private sector (combining different type of businesses) goods and services in the South African economy and a description of the methodology as used in the study.

3. Methodology

3.1. Data and Model Specification

The empirical section of the study is based on quantitative processes. Quarterly data was employed to analyse the relationship between aggregate expenditure components and job creation in the private sector. The data was acquired from the South African Reserve Bank (SARB), for the period ranging between the first quarter of 1994 and the second quarter of 2016. Variables comprise ok employment in the private sector and four components of aggregate expenditure: i.e. private consumption expenditure, government spending, investment spending and net export. These components of expenditure are in real values. Employment in the private sector is regarded as the dependent variable, while other variables are considered independent variables. An Autoregressive Distributed Lag model (ARDL) developed by Pesaran *et al.* (1996) and revised by Pesaran *et al.* (2001) was adopted to analyse the long run relationship amongst variables. The benefit of this model is its flexibility regarding the cointegration order of variables. It can be used whether variables are integrated at levels I (0) or first order I (1) or a mixture of the two. Furthermore, with the ARDL model, different numbers of the optimum lags can be simultaneously used. The following model was formulated to determine the relationship between the aggregate expenditure components and employment in the private sector**:**

$$\Delta LEBUS_t = \alpha_0 + \sum_{j=1}^{k} \beta_j \Delta LEBUS_{t-j} + \sum_{j=1}^{k} \gamma_j \Delta LCONS_{t-j} + \sum_{j=1}^{k} \delta_j \Delta LGOVS_{t-j} + \sum_{j=1}^{k} \tau_j \Delta LINVES_{t-j} + \sum_{j=1}^{k} \vartheta_j \Delta LNEXP_{t-j} + \varphi_1 LEMP_{t-1} + \varphi_2 LCONS_{t-1} + \varphi_3 LGOVS_{t-1} + \varphi_4 LINVES_{t-1} + \varphi_5 LNEXP_{t-j} + u_t \quad (1)$$

Where $\Delta LEBUS_t$ denotes the change in the natural logarithm of employment in the private sector at time t; $\Delta LCONS_t$ denotes change in the natural logarithm of household consumption at time t; $\Delta LGOVS_t$ symbolises change in natural logarithm of total government spending at time t; $\Delta LINVES_t$ symbolises change in the natural logarithm of investment spending at time t; whilst $\Delta LNEXP_t$ symbolises change in the natural logarithm. The $\propto_0$ denotes the intercept, k represents the number of lags used, β_j, γ_j, δ_j, τ_j and ϑ_j represent the short run dynamic, while φ_1, φ_2, φ_3, φ_4 and $\varphi_5$denote the long run relationship. Equation 1 was used to estimate four ARDL model applied to the four components of the aggregate expenditure (consumption, government spending, investment and net export). From Equation (1), the following null and alternative hypotheses were formulated to determine whether variables co-integrated or not.

- For no co-integration, the null hypothesis (H0): $\varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = \varphi_5 = 0$
- For cointegration, the alternative hypothesis (H1): $\varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4 \neq \varphi_5 \neq 0$

The bound test, known as the Wald F-test in the ARDL model, was employed to test these two hypotheses. The test aimed to compare the estimates of the F-value and the critical value from the Pesaran *et al.* (2001) Table. If the estimated F-value is greater than the critical value from the table, the null hypothesis is rejected, suggesting that in the long run, the analysed variables co-integrate. In other words, a long run relationship exists amongst variables. However, if the calculated F-value is lower than the critical value from the table, the null hypothesis is not rejected. In other words, there is no long-run relationship among variables. In the absence of further information, the results are inconclusive if the calculated F-value lies between the lower and upper critical values (Dube & Zhou, 2013). The next step of error correction (ECM) depends upon the outcome of the cointegration test. Without a long run relationship among variables, there is no error correction. Nevertheless, the presence of co-integration suggests the error correction ipso facto. If variables in Equation 1 co-integrate, the following is the equation for the error correction:

$$\Delta LEBUS_t = \alpha_0 + \sum_{j=1}^{k} \beta_j \Delta LEBUS_{t-j} + \sum_{j=1}^{k} \gamma_j \Delta LCONS_{t-j} + \sum_{j=1}^{k} \delta_j \Delta LGOVS_{t-j} + \sum_{j=1}^{k} \tau_j \Delta LINVES_{t-j} + \sum_{j=1}^{k} \vartheta_j \Delta LNEXP_{t-j} + \delta ECT_{t-1} + u_t \quad (2)$$

Where ECT denotes the error correction term and is the coefficient of the error term δ measuring the speed of adjustment towards the long run equilibrium. The correlation analysis was performed to establish relationships between variables. Based on its accuracy, regardless of the size of employed data, Schwarz’s Bayesian information criterion was chosen to determine the maximum number of lags to be used by the study (Brooks, 2014). Additionally, a number of diagnostic tests, i.e. serial correlation, heteroscedasticity, normality and stability, were performed; and the model passed all of these tests.

3.2. Granger Causality Test with the Toda–Yamamoto Approach

Since the ordinal Granger causality (1969) test assumes that the series are integrated at the same order and may provide invalid results if variables have different order of integration (Toda & Yamamoto, 1995; Giles & Mizra, 1998; Mavrotas & Kelly, 2001). This study employed the modified Wald (MWALD) test as suggested by Toda and Yamamoto (1995) to avoid the mentioned issues. The Toda-Yamamoto approach ignores whether variables are I (0), I (1) or I (2); this minimises the risk of deriving incorrect results that may be caused by disparities in order of integration and the size of variables' simple size (Giles, 1997). Using the Toda and Yamamoto (1995) approach to test for Granger non-causality, the following VAR equations were estimated:

$$LEBUS_t = \alpha_0 + \sum_{j=1}^{k} \beta_1 LEBUS_{t-j} + \sum_{j=k+1}^{k+dmax} \beta_2 LEBUS_{t-j} + \sum_{j=1}^{k} \gamma_1 LCONS_{t-j} + \sum_{j=k+1}^{k+dmax} \gamma_2 LCONS_{t-j} + \sum_{j=1}^{k} \delta_1 LGOVS_{t-j} + \sum_{j=k+1}^{k+dmax} \delta_2 LGOVS_{t-j} + \sum_{j=1}^{k} \tau_1 LINVES_{t-j} + \sum_{j=k+1}^{k+dmax} \tau_2 LINVES_{t-j} + \sum_{j=1}^{k} \vartheta_1 LNEXP_{t-j} + \sum_{j=k+1}^{k+dmax} \vartheta_{j2} LNEXP_{t-j} + \varepsilon_{1t} \quad (3)$$

Equation 3 is derived from Equation (1) and they are also defined in the equation. Granger causality from Equations 3 to 7 implies that $\beta_1$to β_2 ; γ_1 to γ_6 ; δ_1 to δ_6 ; τ_1 to τ_6 and ϑ_1 to ϑ_6 differ from 0 $\forall_t$; the estimation of the model was based on the seemingly unrestricted regression suggested in Rambaldi and Doran (1996). In the Equations 3 to 7, *dmax* denotes the maximal order of integration.

4. Empirical Findings and Discussion

4.1. Unit Root Tests

Unit root tests are important tests in econometric analysis, in determining the type of model to be estimated. Tests were conducted using the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests. The results, as exhibited in Table 1, show that all variables passed the unit root test at either the first difference I(1) or at levels I(0). Therefore, the ARDL model can be used to analyse the relationship among variables.

Table 1. Results of ADF and PP Unit root test (p-values)

Variable	ADF Levels	PP Levels	ADF 1st difference	PP 1st difference	Integration order result
LCONS	0.642	0.593	0.0113*	0.0117**	I(1)
LGOVS	0.5224	0.2705	0.0000**	0.0000**	I(1)
LINVES	0.4630	0.3517	0.000**	0.000**	I(1)
LEXP	0.4801	0.6114	0.0001**	0.0001**	I(1)
LEBUS	0.0000**	0.0000**	0.0000*	0.000**	I(0)

* denotes the rejection of the null hypothesis of unit root at the 1% level of significance

** denotes the rejection of the null hypothesis of unit root at the 5% level of significance

4.2. Model Selection and Long-Run Analysis

The number of lags to be utilised in this study was determined; the optimum number of lags was 4. Using the Akaike Information Criteria (AIC), the best model selected was: ARDL (2, 4, 1, 3, 1).

The long-run relationship amongst the selected variables was tested using the bound test of co-integration and the method used to formulate hypotheses as well as by comparing the estimated F-value to critical values. A summary of results obtained is displayed in Table 2. The estimated F-value of 9.4974 is greater than the upper bound critical value, at all levels of significance (10%, 5%, and 1%), 5.06; 4.49; 4.01; and 3.52 respectively, implying that the null hypothesis of no long-run relationship (no co-integration) can be rejected in favour of the alternative hypothesis. These results suggest that there is a long-run relationship between aggregate expenditure components and job creation in the private sector. This relationship can be explained by the fact that the private sector accommodates people with different skills. Highly skilled as well as lower skilled people can be employed in the private sector, depending upon the type of business or firm in which those skills are needed. Moreover, the private sector is the niche of self-employment, especially in urban and rural areas. Therefore, this can explain why higher levels of spending in this sector could positively affect job creation. Numerous other studies from various scholars such as Birch (1979), Neumark *et al.* (2008), Freund (2011), Criscuolo *et al.* (2014) and Kerr *et al.* (2014:2) reported that increasing spending in the private sector could be one of the remedies for reducing unemployment as well as inducing the creation of employment. Based on the outcome of the long run relationship analysis, the following equation was constructed:

$$LEBUS = 28.3672 - 3.1063LCONS - 4.2371LGOVS + 0.4491LINVES + 1.8213LEXP0 \quad (4)$$

Equation 4 indicates a long run coefficient of 28.3672 and that two (investment spending and net exports) of four components of aggregate expenditure have positive long run effects on job creation in the private sector. The values represented in equation 4 indicate that a 1 percent increase in investment spending and an increase of 1 unit in net exports could result in 0.45 and 1.82 percent increases respectively in jobs created in the private sector. However, households' consumption and government spending have a negative effect on private sector employment. Thus, a 1 percent increase in this consumption and such spending causes employment in the private sector to decline by 3.11 and 4.24 percent respectively. Exports have a high positive effect on private sector job creation while government spending has an even higher negative effect on jobs in the private sector. These results contradict the Keynesian theory, suggesting that consumer consumption and government spending increase employment (labour demand). In this case it should be indicated that most of the South African government's spending is allocated for consumption and social welfare, which in this study has proven to have a negative effect on job creation in the private sector.

4.3. Short-run Relationships and Error Correction Model

Due to the fact that the results from the Bounds co-integration test revealed the presence of a long-run relationship, it was necessary to analyse the short-run relationship amongst the variables and perform the error correction model (ECM) in order to determine the time it takes for changes in the system to return to the long run equilibrium.

Table 2. Bounding co-integration test for Private sector

Dependent variable LEBUS	**Estimated F-Statistic: 9.4974**	
Critical Values*	**Lower Bound Critical Value**	**Upper Bound Critical Value**
1%	3.74	5.06
2.5%	3.25	4.49
5%	2.86	4.01
10%	2.45	3.52

Note: * critical values from Pesaran *et al.* (2001) Table CI (V)

The short-run results would also determine whether spending in the private sector could create short-term employment or not. In addition, it would indicate which component of aggregate expenditure favours short-term jobs in the private sector. The results of short-run relationships between aggregate expenditure and job creation in the private sector are depicted in Table 3. From this table, consumer consumption and investment spending are statistically significant at a 5 percent level of significance. Government spending is significant at just 10 percent, indicating a weak short-run relationship with employment. Therefore, to stimulate job creation in the private sector in the short term, more resources should be allocated towards consumption and investment spending. This result suggests that government spending has a weak significant effect on employment in private sector, while export revenues do not affect employment in the private sector. These results are supported by the findings of Haltiwanger *et al.* (2010) and Freund (2011). Their studies reached the conclusion that the size of firm affects its level of employment so that, in many cases, starting businesses may destroy more jobs than are created.

Table 3. Short-run relationship and error-correction results

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(EMP(-1))	0.1472	0.1127	1.3058	0.1959
D(LCONS)	27.3059	63.8101	0.4279	0.6754
D(LCONS(-1))	387.7393	114.5621	3.3845	0.0012*
D(LCONS(-2))	-270.7143	116.1190	-2.3313	0.0226*
D(LCONS(-3))	123.6799	64.2445	1.9251	0.0583
D(LGOVS)	26.9978	14.8185	1.8218	0.0727
D(LINVES)	19.6715	13.8237	1.4230	0.1592
D(LINVES(-1))	-52.0671	21.0563	-2.4727	0.0158*

D(LINVES(-2))	32.4029	14.2996	2.2659	0.0265*
D(LEXPO)	9.6151	6.6352	1.4491	0.1518
CointEq(-1)	-0.9760	0.1444	-6.7553	0.0000*

Note: *rejection of null hypothesis at 5% level of significance

In addition, the model presents a statistically significant error correction term (ECT) of -0.9760 with a negative sign. This means that approximately 97% of shocks in the system will be fixed in each quarter. In other words, it will take approximately 1.02 (1/0.9760) quarters for the changes in aggregate expenditure to affect job creation in the private sector. This suggests that aggregate expenditure can be used to stimulate jobs in business enterprises. Based on the aforementioned results, it is beneficial to determine the causality amongst the variables to indicate which variable of aggregate expenditure causes short run employment in the private sector and the responsiveness of employment towards aggregate expenditure components.

The modified Wald (MWALD) or Toda-Yamamoto Granger causality test was used to determine the short-run causal relationship between the variables. The results are indicated in Table 4. A bi-directional causal relationship exists only between consumption and employment in private sector, and between investment spending and employment in the aforementioned sector. However, there is no causal relationship between government spending, exports and employment in the private sector. A mutual causal relationship exists among all independent variables and private employment except export, which is neither causing nor being caused by any other component of aggregate expenditure (the outcome for causal relationships among independent variables analysis is not reported in this paper).

Table 4. Toda-Yamamoto Causality (MWALD) Test Result

Null hypothesis	Chi-sq	Prob.	Granger Causality
LCONS does not Granger Cause LEBUS	10.12855	0.0015*	Bidirectional causality
LEBUS does not Granger Cause LCONS	2.974287	0.0846**	
LGOVS does not Granger Cause LEBUS	0.029938	0.8626	No causality
LEBUS does not Granger Cause LGOVS	1.693334	0.1932	
LINVES does not Granger Cause LEBUS	13.52651	0.0002	Bidirectional causality
LEBUS does not Granger Cause LINVES	4.541558	0.0331	
LEXPO does not Granger Cause LEBUS	0.359915	0.5486	No causality
LEBUS does not Granger Cause LEXPO	0.000549	0.9813	

Note: * rejection of null hypothesis at 5% level of significance

** rejection of null hypothesis at 10% level of significance

4.4. Residual Diagnostic Tests

In this section of the study residual tests are performed to determine the correctness of the results. The Lagrange Multiplier test was carried out to detect the presence of auto-correlation among variables, while the White Heteroscedasticity was used to distinguish whether variables are homoscedastic or heteroscedastic. Finally, the normality test was performed using the Jacque-Bera test. Findings revealed that the used series was homoscedastic and also normally distributed, and residuals are not auto-correlated. This implies that the findings are trustworthy.

5. Conclusions

The study dealt with the interaction between aggregate expenditure and job creation in the private sector. The analysis revealed that sustainable jobs can be created in this sector by increasing the level of investment spending and the quantity of exported goods and services. In the long run, exports were found to be the key component for job creation in the private sector, while consumption and government spending destroy jobs in this sector. South African households seem to consume or spend more on imported goods and services, which might explain why consumption does not affect long term employment in the private sector. If government spending and consumption have a negative effect on employment creation in the private sector, the assumption should be that a positive correlation exists between households' consumption and government spending. Although consumption does not by itself have a long run effect on employment in the private sector, together with investment spending these two components of aggregate expenditure could be useful for short-term job creation.

6. References

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