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Lelani Coetzee[1] Goodness C. Aye[2]

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This paper examines the causal relationship between the exchange rate and stock prices and the effect of the financial crisis on this relationship using monthly time series data and VAR-based approach. It further analyzes the long-run relationships. The results show that exchange rate and stock prices were unrelated prior to the crisis, yet the interdependence between these markets has increased since the crisis as there is now unidirectional Granger causality from stock prices to the exchange rate. It further confirms that the variables exhibit long-run cointegrating relationships. Also an increase in stock prices leads to an appreciation of the exchange rate. Monetary policy that targets inflation through interest rates will inevitably affect investment which in turn affects capital flows, money demand and thus the exchange rate. The government can strive towards a stable exchange rate and growth in the stock market by avoiding sharp swings in monetary policy.

Keywords: Exchange rate; stock price, long run; causality, global financial crisis

JEL Codes : C32, F31, G01, G15

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1 Introduction

The global financial crisis of 2008 increased awareness of the interdependence between local and global financial markets and the extent to which economic variables affect one another. The crisis raised questions about the channels of monetary policy and whether it is effective in impacting the economy. The post-Apartheid reintroduction of South Africa to global financial markets drastically changed the investment environment in South Africa. Local and international investors' confidence increased which resulted in increased capital flows and cross-

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border transactions, and raised South Africa’s profile as an emerging market (Oberholzer & von Boetticher, 2015).

The reintegration of the local economy with global markets introduced new risks associated with investment in South Africa since movements in international markets could now influence the domestic market. For example, Kuttu (2014) illustrates these risks by showing that the volatility spillover from returns on the Nigerian equity market to the South African equity market is quite significant. Capital flows, stock prices, international trade and exchange rates are all interrelated factors with spillover effects that occur among them.

Foreign direct investment (FDI) in South Africa is very low due to the perception that investments in South Africa have high risks. This perception is largely based on the volatile exchange rate, episodes of political uncertainty, frequent labour strikes and poor macroeconomic performance. In an attempt to mitigate the exchange rate risk of investing in South Africa, the Reserve Bank’s Monetary Policy Committee (MPC) has to continuously assess what the effects of their policies are on the development of the domestic stock market under a floating exchange rate regime. In order to increase FDI (which should ultimately aid in improving economic growth), the local economic environment has to become more stable.

For the South African government to create a more stable economic environment with regards to capital flows, stock prices and exchange rates, the relationships among these variables have to be known. The objective of this study is to evaluate the causal relationship between the Rand/Dollar exchange rate and the JSE All Share Index in South Africa from July 1995 to March 2016. The results of the analysis are crucial to policy makers, investors and firms alike. If causality runs from exchange rates to stock prices, monetary policies should be implemented with caution by first conducting thorough impact analyses with regards to currency risk hedging, portfolio investment and trade. If causality runs from stock prices to exchange rates, the Reserve Bank should attempt to stabilize capital flows through interest rates that affect money demand. An attempt to stabilize capital flows could aid in stabilizing the exchange rate by reducing large exchange rate fluctuations.

This study contributes to the existing literature by examining the causal relationship between exchange rates and stock price. It furthermore extends the time period to examine whether the global financial crisis of 2008 affected South Africa’s currency and stock market through a change in capital flows. The remainder of this paper will review the existing literature on the linkages between exchange rates and stock prices, discuss the data and econometric methodology used, interpret the results of the analysis and mention the implications the results have to investors, firms and policy makers.

2 Literature Review

South Africa's economy was reintegrated with global economies in 1994, when all sanctions against South Africa were lifted due to the inception of democracy. The reintegration introduced spillover effects from international to local markets, and it increased South Africa's profile as an emerging market that presents investment opportunities. Investors constantly search for cost-effective investments, diversification and low investment risk (Oberholzer & von Boetticher, 2015). One of the risks associated with investing in South Africa is a fluctuating exchange rate that could greatly reduce the value of an investment when converted into foreign currency. The value of the South African Rand fluctuates against other currencies due to spillover effects from foreign markets and fluctuating volumes of cross-border transactions of both goods and capital.

Many studies have been conducted to analyze the direction of causality between exchange rates and stock prices in both developed and emerging markets. International investors ideally want these markets to be unrelated to decrease their risk, whilst policy makers have to be aware of the effects that their monetary policies can have on investment yields should these markets be related. Theoretical frameworks explain the two possible unidirectional linkages, namely the Dornbusch and Fischer (1980) flow-orientated model and the stock-orientated model by Frankel (1983). The literature shows inconsistent results regarding the direction of causality between the two markets that are clearly country specific.

The Dornbusch and Fisher (1980) flow-orientated model explains the unidirectional causality from exchange rates to stock prices. Their model is developed from a macroeconomic perspective that stock prices reflect the present value of the expected future cash flows of a firm, consequently any occurrence affecting the firm's cash flow will be reflected in the stock price of that firm.

The effects of an appreciation or depreciation of the local currency is easily illustrated. A depreciation of the domestic currency improves the competitiveness of local firms which increases their exports and consequently their expected future cash flows (Dornbusch & Fischer, 1980). Stock prices will rise in response to the increased expected future cash flows. In contrast, a currency appreciation makes domestic products more expensive for foreign buyers since foreign currency can now purchase less of the domestic currency. Products abroad become more expensive and the value of international sales fall when expressed in terms of the local currency. Exports are negatively affected by the reduced foreign purchasing power and stock prices will fall (Dornbusch & Fischer, 1980).

Aggarwal (1981) further explains the causality from exchange rates to stock prices through international trading. His hypothesis is based on traditional theory which suggests that international trade is affected by exchange rates. Changes in a country's exchange rate affects the country's international competitive advantage, real income and output (Dornbusch & Fischer, 1980). Aggarwal (1981) states that a change in the exchange rate affects multinational, export-orientated and domestic firms alike. Changes in the exchange rate continuously affect the value of foreign operations and the profitability of multinational firms.

The stock-orientated model by Frankel (1983), also referred to as the portfolio balance approach, explains the directional causality from stock prices to exchange rates through capital account transactions. The model shows that portfolios which are internationally diversified trade in foreign assets, and the demand and supply of these assets are influenced by changes in stock prices. Foreign and domestic investors trade foreign securities in response to stock price movements and these changes in capital flows affect the currency market.

The dynamics of how investors react to stock price movements are explained by Bahmani-Oskooee and Sohrabian (1992). The authors show that investors' wealth increases when an exogenous shock leads to an increase in stock prices. Local authorities increase interest rates due to an increase in the demand of local currency, which further improves the attractiveness of local investments. Capital flows in- crease since more investments are made and the currency then appreciates due to the higher demand thereof (Tsai, 2012). The opposite is true when the local stock market index decreases. Investors' wealth decreases which reduces the demand for money and results in a lower interest rate (Liang-Chun & Chia-Hsing, 2015). A lower interest rate paired with lower stock prices make local investments unattractive which reduces capital inflows and thus causes the local currency to depreciate.

The credibility of the unidirectional theoretical frameworks of Dornbusch and Fischer (1980) and Frankel (1983) are both improved when the role of international trade is incorporated. For export-orientated firms, a depreciation in the currency will improve the competitiveness of exports and increase the costs of imports (Tsai, 2012). A currency depreciation will thus increase the stock prices of exporting firms and decrease the stock prices of firms that import inputs or goods. The net effect of a currency depreciation in South Africa is thus difficult to conclude without empirical evidence.

The dynamics explained by the Dornbusch and Fischer (1980) flow orientated model and the stock-orientated model by Frankel (1983) are usually present simultaneously. The unidirectional causality from exchange rates to stock prices or vice versa is thus a net effect of the different dynamics. The net effect can easily differ depending on the data, methodology and country, which explains why the literature shows inconsistent results in the causal relationship between exchange rates and stock prices.

The literature shows that the results among advanced economies are inconsistent. Caporale, Hunter and Ali (2014) examined the nature of the relationship between currency and stock markets in the UK, US, Canada, Japan, Switzerland and the Euro area during the banking crisis period of 2007 to 2010. The results show unidirectional Granger causality from stock prices to exchange rates in the UK and US, bidirectional causality in Switzerland and the Euro area, and causality from exchange rates to stock prices in Canada. The findings furthermore show an increase in the interdependence of these two variables during the banking crisis time period, indicating the difficulty of hedging against risk by diversifying assets during this time.

Emerging economies also yield inconsistent results. Liang-Chun and Chia-Hsing (2015) conduct a similar study for the BRIC countries, excluding South Africa from their study. The authors use the Lagrange multiplier principle to study the causality in variance and relationship between stock indices and exchange rates. The results of the analysis illustrate the dispersions between the interdependence of these two markets in different countries. In Brazil and India the causality runs from exchange rates to stock prices; in Russia the variables exhibited a bilateral relationship; in China no causal relationship could be established. The authors conclude that the 2008 global financial crisis resulted in structural changes in stock markets, consequently altering the causal relationship between exchange rates and stock prices in certain countries. They furthermore show that that volatility can be transmitted between exchange rates and stock indices even if the variables are statistically uncorrelated.

Literature concerning South Africa study the volatility relationships between the currency and stock market, and changes in volatility of the stock market due to exogenous shocks. Oberholzer and von Boetticher (2015) use daily closing values of the top five indices on the Johannesburg Stock Exchange (JSE) from January 2002 to September 2014 and employ a multivariate CCC-GARCH(1,1) model to study the inter-market relationship between the South African Rand and these indices. The results show a unidirectional volatility spillover from the exchange rate to four of the five main indices on the JSE.

Mlambo, Maredza and Sibanda (2013) employ a GARCH(1,1) model in a similar study which also analyzes the relationship between stock markets and the volatility of the exchange rate. The results are based on monthly data from 2000 to 2010 and contradict the findings of Oberholzer and von Boetticher (2015). Mlambo, Maredza and Sibanda (2013) find that there is a weak relationship between the exchange rates and stock prices and conclude that the JSE can be marketed as a relatively safe investment for foreign investors.

Oberholzer and Venter (2015) analyze the daily volatility of five main indices on the JSE. The study is conducted from 2002 to 2014 to analyze the effect that the global financial crisis had on the volatility of stock prices. The authors state that international markets and local political and investment factors have influenced the South African equity market since 1994. Consequently, the study is divided into three distinct time periods to explore changes in volatility during the financial crisis of 2007-2009. They find that the GJR-GARCH model is the best fitting model to quantify and forecast the volatility of the JSE for the full time period. Overall, they find that the rise in volatility is of greater magnitude after a large negative shock than after a large positive shock.

The different results of the relationship between stock prices and exchange rates can be explained since the relationship is a net effect of the portfolio balance approach and the flow orientated model. The portfolio balance effect can also not occur permanently since the absorption of foreign capital in the market depends on the volatility of the local stock market (Tsai, 2012). If the stock market presents a clear opportunity for profitability or loss, the exchange rate will be influenced by the increase in capital inflows or outflows. If no exogenous factor drastically influences capital flows, only the trading effect will exist in the relationship between the two markets (Tsai, 2012).

South Africa has a large number of both importing and exporting firms which makes it difficult to theoretically conclude the net relationship between stock prices and the exchange rate, thus empirical analysis is required.

3 Data

The empirical analysis uses time series data from July 1995 to March 2016. This time period includes the global financial crisis of 2008 that started with the subprime mortgage crisis in the United States in 2007, to analyze whether the crisis affected the causal relationship between stock prices and the exchange rate. The variables used to determine the long-run and short-run relationships between the exchange rate and stock prices are the Rand/Dollar exchange rate (ER), JSE All Share Index prices (SP), 91-day Treasury Bill rate (TB), headline consumer price index (CPI), commodity price index (COMPI) and the trade share of GDP (TRADE). The log of all variables are used to allow the estimated coefficients in the model to be interpreted as elasticities.

The data is sourced from the International Financial Statistics provided by the International Monetary Fund, the South African Reserve Bank and Statistics South Africa. The 91-day Treasury Bill rate is the percentage annual return expected on a three-month South African treasury bill and also reflects the risk premium associated with investing in South Africa. The consumer price index measures inflation in South Africa and the commodity price index is a weighted average of selected commodity prices. The commodity price index is included based on the findings of le Roux (2015) which shows a cointegrating relationship between seven soft commodities, the FTSE/JSE Top 40 Index and the South African Rand. The trade share of GDP is an openness measure which is constructed as the sum of imports and exports divided by gross domestic product.

4 Econometric Methodology

To estimate the long-run relationships among the variables, the presence of cointegrating vectors are tested using the Johansen (1988) multivariate cointegration technique. The analysis first tests the order of integration of each variable by determining the number of unit roots of each variable. All non-stationary variables can then enter the vector autoregressive (VAR) model once the order of the VAR is determined to ensure that the errors in the vector error correction model (VECM) are Gaussian distributed.

The reduced-form VAR model of the appropriate lag length is then estimated and a rank test of the VAR indicates the number of cointegrating vectors that are present. The reduced-form VAR can then be reformulated and estimated as a VECM model, where the estimates show both the long-run relationships and short-run error correction terms among the endogenous variables.

The direction of causality between stock prices and the exchange rate is determined by the Granger (1969) causality test. To employ the test the two variables are differenced and an unrestricted VAR model is estimated on the differenced variables. The Granger causality test is then employed based on the estimated VAR model. This procedure is conducted separately on the data before and after the global financial crisis to determine whether the crisis affected the causal relation- ship between these two variables.

4.1 Unit root tests

The order of integration of each variable has to be determined prior to the cointegration analysis. Traditional unit root tests, for instance the Augmented Dickey-Fuller (1981) test, ignore structural breaks in the data. Perron (1989) shows that the null- hypothesis becomes more difficult to reject in the presence of a structural break when the structural break is ignored, since structural changes and unit roots are closely related. The presence of structural breaks may thus lead to an under rejection of the null hypothesis of the presence of unit roots if the data is trend stationary with a structural break.

To account for the possibility of an under-rejection of the null hypothesis, the Augmented Dickey-Fuller (ADF) test is used in conjunction with the Perron unit root test that allows for a structural break in the data.

The variant of the Augmented-Dickey Fuller unit root test, which accounts for both a trend and intercept in the data generating process, is tested by the following equation:

$$\Delta y_t = \mu + \delta_t + \rho^* y_{t-1} + \sum_{i=1}^{p-1} \rho_i \Delta y_{t-i} + \varepsilon_t \qquad (1)$$

The null and alternative hypotheses are defined as:

$$H_0 : \rho^* = 0$$
$$H_a : \rho^* < 0$$

The test statistic follows a τ_τ distribution and is given by:

$$\frac{\hat{\rho}^*}{se(\hat{\rho}^*)}$$

The Perron unit root test considers a multiple regression model with T time periods and m possible structural breaks. The m possible breaks produce $m+1$ regimes, thus for the observations $T_i, T_i + 1, ..., T_{i+1} - 1$ in regimes $j = 0, ..., m$, the following regression model exists:

$$y_t = X_t^{'} \beta + Z_t^{'} \delta_i + \varepsilon_t \qquad (2)$$

where the parameters of X do not vary across regimes, while those of Z are regime- specific. The breakpoint date is defined as the first date of the subsequent regime. Once the breakpoints are defined, the test equation is estimated and the null hypothesis of a unit root with a structural break is tested.

4.2 Johansen cointegration

The maximum lag length has to be correctly specified once the order of integration of the variables is determined. Too many lags will result in less degrees of freedom and possible multicollinearity, while too few lags can result in specification errors. In this paper the AIC criterion is used to determine the number of lags. After establishing the order of the VAR model, the reduced-form VAR model can be estimated and the presence of cointegrating vectors is tested by testing for reduced rank.

The unrestricted VAR model, as proposed by Sims (1980), estimates the dynamic relationships among jointly endogenous variables without imposing particular structural relationships or exogeneity of certain variables. The general compact formulation is given by a matrix representation of a reduced-form VAR(k) model, where n is the number of endogenous variables in the system and k is the number of lags of z_t:

$$z_t = A_1 z_{t-1} + ... + A_k z_{t-k} + \mu + \varepsilon_t \qquad (3)$$

In this case z_t is an $(n \times 1)$ matrix and each of the is an $(n \times n)$ matrix of parameters. Using the lag operator L to define $\Delta = 1 - L$, the above equation can be reformulated as:

$$z_t = \Gamma_1 \Delta x_{t-1} + ... + \Gamma_k \Delta z_{t-k+1} + \Pi x_{t-k} + \mu + \varepsilon_t \qquad (4)$$

This equation is a reformulation of the VAR model which results in a VECM,

and can be simplified to:

$$\Delta x_t = \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-k} + \mu + \varepsilon_t \qquad (5)$$

where $\Gamma_i = (I - A_1 - ... - A_i),\ i = 1,...k-1$ and $\Pi = -(I - A_1 - ... - A_k)$.

The parameters Γ and μ can vary without restrictions and the $x's$ are fixed. The estimates of Γ_i thus contain information regarding short-run adjustments to changes in x_t, while estimates of Π contain information regarding long-run adjustments to changes in x_t.

The rank of Π finds the number of r linearly independent columns in Π which is equivalent to the presence of cointegration. If there are n endogenous variables, then there are $(n \times r)$ matrices α and β such that $\Pi = \alpha\beta'$, thus $0 < \mathrm{r}ank\,(\Pi) < n$. In matrix Π, α represents the speed of adjustment to equilibrium (the error-correction terms), and β is a matrix of long-run coefficients which ensures that z_t converge to their long-run equilibrium solutions (thus contains the cointegration vectors).

The Johansen procedure suggests the trace test and the maximum eigenvalue test to determine the rank of Π. The trace test tests the null hypothesis that the number of cointegrating vectors are at most equal to r, while the maximum eigenvalue test tests the null hypothesis that there are r cointegrating vectors. The sequence of the trace tests leads to a consistent procedure, while the maximum eigenvalue test has a sharper alternative hypothesis and is preferred for determining the exact number of cointegrating vectors (Lutkepohl, Saikkonen, & Trenkler, 2001).

If there are more than one cointegraing equation, the identification issue arises and restrictions have to be imposed when estimating the VECM. The identifying restrictions are imposed on the dependent variable in the following equation:

$$\Pi x_{t-1} = \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \end{pmatrix} \times \begin{pmatrix} \beta_1 & \beta_2 & \beta_3 & \beta_4 & \beta_5 \end{pmatrix} \times \begin{pmatrix} SP \\ ER \\ CPI \\ COMPI \\ TB \end{pmatrix}_{t-1} \qquad (6)$$

4.3 Granger causality

The Granger (1969) causality approach determines whether the current values of x can be explained by past values of x, and whether the explanation can be improved by adding lagged values of y. To test Granger causality between two variables, the following bivariate regressions are tested for all possible pairs of (x, y)

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_i x_{t-i} + \beta_1 y_{t-1} + \ldots + \beta_i y_{t-i} + \varepsilon_t \qquad (7)$$

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_i y_{t-i} + \beta_1 x_{t-1} + \ldots + \beta_i x_{t-i} + u_t \qquad (8)$$

where i is the lag length.

The joint null-hypothesis is defined as:

$$H_0 = \beta_1 = \beta_2 = ... = \beta_i = 0$$

The hypothesis states that y does not Granger-cause x in the first equation, and x does not Granger-cause y in the second equation. The rejection of the null-hypothesis is based on the F-statistics and the Wald statistics.

5 Results

5.1 Unit root tests

Formal unit root tests (the Augmented-Dickey Fuller and Perron tests) are used in conjunction with an informal interpretation (visual inspection) of the univariate characteristics of the variables. The informal interpretation also aids in the specification of the variant of formal unit root test to use.

The time series graphs plot the levels series of all variables against its corresponding first differenced series in Figure 1. With the exception of the trade share variable, all other variables appear non-stationary in levels, yet stationary in their first differenced series. The underlying data generating processes of all the level variables have both a trend and intercept, while that of the first differenced variables only have an intercept.

[Figure 1 here]

Table 1 shows the results for the formal unit root tests. The Augmented Dickey-Fuller test considers the null hypothesis that the variable under consideration has a unit root, while the Perron test considers the null hypothesis that the variable under consideration has a unit root with a structural break. The tests are conducted on both the level and first difference series of the variables and the t-statistics of the tests are reported.

The results conclude that all variables, with the exception of trade share of GDP, are non-stationary in levels and stationary in first difference. The results for the univariate characteristics of trade share of GDP are contradictory as the Perron test shows that the series is integrated of order 0, while the ADF test shows integration of order 1. Since the visual inspection supports the Perron test, the conclusion is that trade share of GDP is stationary and cannot enter the cointegration space.

[Table 1 here]

5.2 Johansen Cointegration and VECM

The Johansen cointegration procedure tests the rank of the matrix that contains information about the long-run adjustments of the endogenous variables. The rank of this matrix is equivalent to the number of cointegrating relationships among the variables. Table 2 shows the results of both the trace test and maximum eigenvalue test, which conclude that the null hypothesis of no cointegrating vectors can be rejected in favour of two cointegrating vectors at a 5% significance level. These long-run equations are estimated by the VECM.

[Table 2 here]

Table 3 shows the estimates of the coefficients of the VECM, which all conform to the theoretical expectations of the relationships between the variables. The two long-run relationships can thus be written as:

$$ER_t = -1.18SP_t - 0.32COMPI_t + 3.05CPI_t - 0.68TB_t \quad (9)$$

$$SP_t = -0.58ER_t - 0.45COMPI_t + 2.51CPI_t - 0.16TB_t \quad (10)$$

Share prices and the exchange rate are negatively correlated in both cointegrating equations. A one percent increase in share prices will result in a 1.18 percent appreciation of the Rand, while a one percent depreciation of the Rand will result in share prices make local stock market investment more attractive to foreigners, thus the demand for Rands increases and the currency appreciates. A depreciation of the ex- change rate makes local currency holdings less attractive relative to foreign currency holdings and subsequently the demand for stock market investment decreases.

Inflation is positively correlated with both the exchange rate and share prices. A one percent increase in inflation will result in a 3.05 percent depreciation of the Rand and a 2.51 percent increase in stock prices, ceteris paribus. In South Africa the economy mainly experiences cost push inflation due to increases in electricity prices, wages and raw materials. As a commodity rich country the economy relies on exports of commodities, thus when the prices of exported goods increase the currency has to depreciate to maintain competitiveness of exports in the interna- tional market. Inflation further decreases the incentive to hold cash since the value decreases over time as inflation rises. Many consumers and investors thus prefer to invest money in an asset that has a growth rate that can compete with the inflation rate. The stock market provides the opportunity for asset growth, thus the demand for stocks increase which leads to higher stock prices.

[Table 3 here]

The Treasury Bill rate is negatively correlated with both the exchange rate and share prices. A one percent increase in the Treasury Bill rate will result in a 0.68 percent appreciation of the Rand and a 0.16 percent decrease in stock prices, ceteris paribus. An increase in interest rates by monetary authorities decreases the purchasing power of consumers and increases the cost of debt to both consumers and businesses. Companies' profits tend to decrease due to lower household spending and reduced profits due to a higher cost of debt. Since share prices reflect the expected future cash flows of a company, share prices will decrease due to lower expected future profits. Higher interest rates do however attract foreign capital since the yield on low risk investments such as government securities increases. The demand for the local currency increases which causes the currency to appreciate.

The commodity price index is negatively correlated with both share prices and the exchange rate. A one percent increase in commodity prices will result in a 0.32 percent appreciation of the Rand and a 0.05 percent decrease in stock prices. A rise in commodity prices causes cost push inflation that monetary authorities attempt to curb by increasing interest rates. The aforementioned economic channel that illustrates how increased interest rates lead do a decrease in stock prices thus applies. South Africa is a net exporter of many commodities, thus when commodity prices increase the exporting firms receive greater revenues. These increased profits positively contribute to the economy, thus the currency appreciates as it is more competitive in the foreign exchange market.

The speed of adjustment coefficients in the first cointegration equation show that approximately 6.1% and 6.8% of the disequilibrium in the equation is corrected each month by changes in the exchange rate and share prices respectively. The negative signs of these adjustment parameters indicate that the series will converge to its long-run equilibrium state due to the adjustments. In the second cointegration equation there are error corrections of approximately 11.1% and 12.64% each month due to changes in the exchange rate and share prices respectively. The positive signs of these adjustment parameters indicate that the series are explosive and will thus diverge from the long-run equilibrium. This outcome is not reasonable as it is inconsistent with the notion of long-run equilibrium, thus the second cointegrating equation is not a good representation of the long-run interaction between the variables.

5.3 Granger Causality

The Granger causality test in Table 4 shows that the global financial crisis of 2008 had an effect on the causal relationship between the exchange rate and stock prices in South Africa. These two variables were unrelated prior to the financial crisis, since there was no causality from one variable to the other. The global financial crisis altered the causal relationship between these two variables - after the crisis there was unidirectional Granger causality from stock prices to exchange rates.

[Table 4 here]

Investors prefer these markets to be unrelated since investments in the stock markets are then not subject to exchange rate risk, as was the case before 2008. Monetary policy employs the interest rate and money supply as tools to target inflation which ultimately affects the exchange rate and thus the investment environment. Stock price investment in South Africa was thus unaffected by changes in monetary policy prior to 2008 which further lowered the risk attached to such investments.

After the financial crisis the portfolio balance approach, which occurs through capital account transactions, prevailed in South Africa. Changes in share prices affect the demand and supply of these assets and by extension the local currency. The South African Reserve Bank can thus enact monetary policy that affects the exchange rate without concern of the effect on share prices. A stable economic environment is crucial for share prices to consistently increase and attract further investment from local residents and foreigners. A stable stock market will reduce large and unexpected fluctuations of the exchange rate that distorts the prices and profits of importing and exporting firms.

Monetary policy does not currently affect the stock market through the ex- change rate, but interest rates do have a direct impact on investment. The Reserve Bank should thus still be cautious when altering the interest rate, since interest rates impact the attractiveness of local investment and thus share prices. The uni-directional causality from share prices to the exchange rate shows how vulnerable the exchange rate is to changes in monetary policy through the interest rate which affects household spending and investment.

Contractionary monetary policy that increases the interest rate is intended to decrease household spending and curb high inflation, while also attracting poten- tial foreign investment due to a higher return to capital (Mishkin, 1996). Local currency deposits are more attractive than foreign currency deposits which increase the demand for Rand and thus cause the currency to appreciate. Higher invest- ment positively contributes to the economy, while an appreciated currency makes exports less competitive in international markets. The opposite analysis is valid for expansionary monetary policy.

Overall, a change in monetary policy will affect both markets although bidirec- tional causality between stock prices and the exchange rate does not exist. For the stock market and investments to positively contribute to economic growth, a stable economic environment is required. The Reserve Bank has managed to keep inflation stable, but the government has to improve political stability and employment to increase investor confidence.

6 Conclusions

This paper employs the Granger causality test and establishes that the interdependence between the exchange rate and stock prices increased after the financial crisis of 2008. It further estimates two long-run relationships between the exchange rate, stock prices, inflation, the commodity prices and the Treasury Bill rate by means of the Johansen cointegration procedure. Causality does not run from the exchange rate to stock prices which indicates that stock market investments do not have ex- change rate risk for local investors, although to foreign investors the value of their investment in terms of foreign currency is still affected by the exchange rate.

The Reserve Bank can attempt to maintain a stable exchange rate by targeting inflation through the interest rate since both these variables affect the exchange

rate. The extent to which the Reserve Bank can maintain a stable exchange rate is limited since share prices and commodity prices also affect the exchange rate. Contractionary monetary policy that targets inflation will however dampen growth in the stock market. To achieve growth in the stock market and maintain a stable exchange rate, monetary authorities should avoid sharp swings in monetary policy to create a stable economic environment conducive of economic growth (Friedman, 1968).

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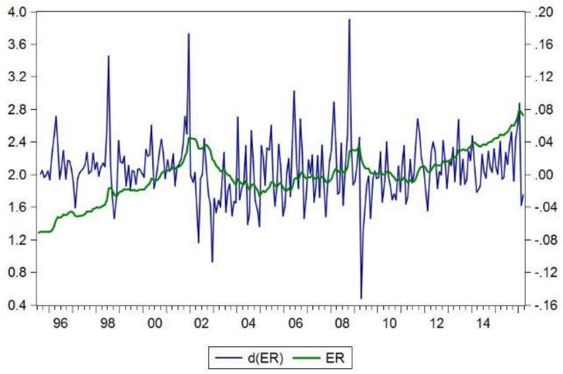
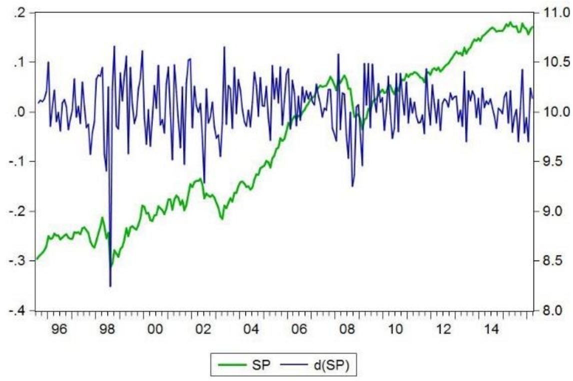
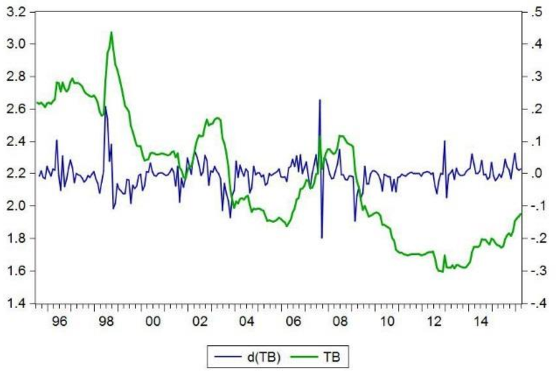
Figure 1: Informal Analysis of Univariate Characteristics



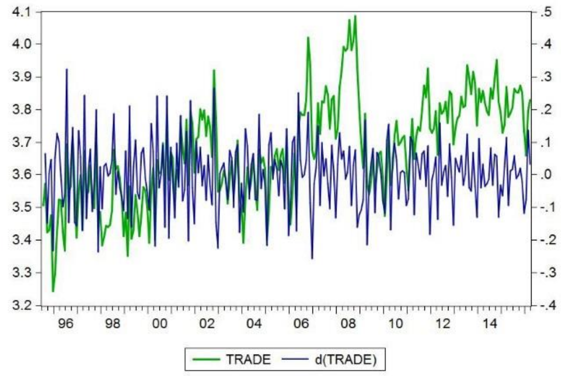
(a) Exchange rates



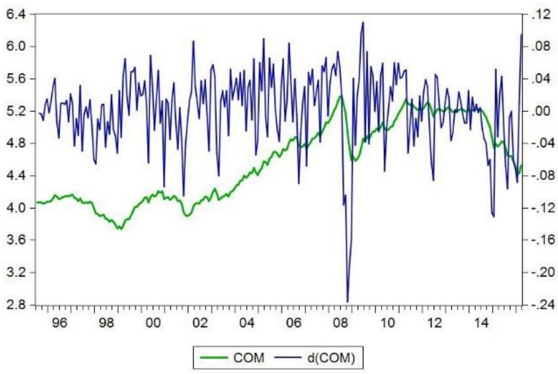
(b) Stock prices



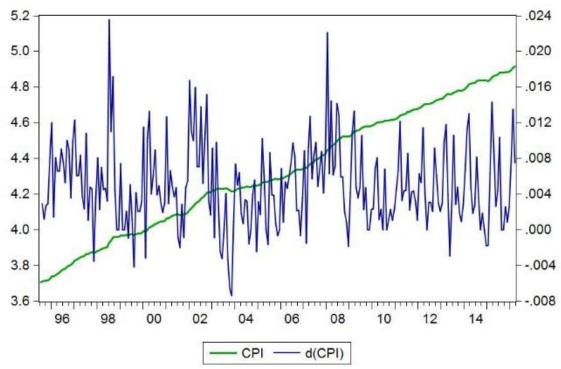
(c) Treasury Bill rate



(d) Trade share of GDP



(e) Commodity Price Index



(f) Consumer Price Index

Table 1: Formal Unit Root Tests

Variable	Perron Level	Perron Differenced	ADF Level	ADF Differenced
ER	-3.325	-13.031***	-2.026	-11.548***
SP	-4.016	-8.057***	-2.602	-16.268***
CPI	-3.509	-11.76***	-2.41	-11.283***
COMPI	-3.333	-11.396***	-1.458	-10.425***
TB	-3.257	-13.365***	-2.56	-18.097***
TRADE	-5.336*	-18.059***	-2.138	-5.472***

*(**)[***] denotes rejection of the null hypothesis at a 10%(5%)[1%] significance level

Table 2: Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	Prob.**
r=0	r ≥ 1	0.392646	210.8647	0.0000*
r≤ 1	r≥ 2	0.208626	87.69991	0.0000 *
r ≤2	r ≥ 3	0.079689	29.90577	0.1663

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Max-Eigen Statistic	Prob.**
r=0	r=1	0.392646	123.1648	0.0000*
r ≤ 1	r=2	0.208626	57.7942	0.0000 *
r ≤ 2	r=3	0.079689	20.5118	0.0871

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 3: Vector Error Correction Estimates

Normalized cointegrating coefficients β

ER	SP	COMPI	CPI	TB	Constant
1	1.175	0.316	-3.049	0.684	-1.869
0.577	1	0.046	-2.513	0.156	0.241

Speed of adjustment coefficients (Error correction terms) α

	ΔER	ΔSP	ΔCOMPI	Δ CPI	Δ TB
CointEq1	-0.061	-0.068	-0.063	0.0036	-0.149
	(-2.616)	(-1.8773)	(-2.2238)	(1.3608)	(-5.7374)
CointEq2	0.1106	0.1264	0.099	1.92	0.2385
	(2.952)	(2.16)	(2.1723)	(0.0046)	(5.6928)

Table 4: VAR Granger Causality Test

Null Hypothesis before the Financial Crisis	Obs	F-Stat	Prob.
SP does not Granger Cause ER	147	0.291	0.589
ER does not Granger Cause SP		0.916	0.339
Null Hypothesis after the Financial Crisis			
SP does not Granger Cause ER	96	10.541	0.0016***
ER does not Granger Cause SP		1.159	0.284

*(**)[***] denotes rejection of the null hypothesis at a 10%(5%)[1%] significance level