Impact of Macroeconomic Variables on Exchange Rate in South Africa

Olumuyiwa Sunday David
my_davies@yahoo.com

ABSTRACT: *Fluctuation in exchange rate has continued to be a major treat to economic growth and maintaining its stability and competitiveness poses serious concern to government and all stakeholders. Despite series of policies and programmes undertaken by governments of various countries, exchange rate instability remains a menace. This paper evaluated the impact of some macroeconomics variables on South Africa's Rand using annual time series data from 1970 to 2021. Multiple regression with OLS estimator was adopted for the data analysis and the results showed that exchange rate has positive relationship with interest rate while it has negative relationship with gross domestic product growth rate and net foreign trade. Although these individual relationships are not significant enough to influence the exchange rate but there is evidence the combine effect of these macroeconomic variables has significant influence on exchange rate in South Africa.*

KEYWORDS: Exchange Rate, Gross Domestic Product Growth, Interest Rate, Net Foreign Trade.

INTRODUCTION

One of the most critical macroeconomic variables in determining the strength and viability of any country's economy is exchange rate (Fraz and Fatima, 2016) and governments and stakeholders have continually make efforts to ensure its stability and competitiveness. The volatility of exchange rate increases exchange rate risk and makes international trade, investment decisions and profit expectation more difficult (Mirchandani, 2013). Many studies have shown that variation in the demand and supply of many macroeconomic factors like GDP, interest rate, inflation, external debt, balance of trade, among others, are the major causes of exchange rate fluctuations (Madura, 2006).

The effect of the Apartheid had considerable negative impact on the political and economic growth of South Africa with drastic depreciation in the exchange rate value. As a result of this, there has been plethora of changes to the exchange rate system in providing measures to stabilize the exchange rate (Mtonga, 2011). Fixed exchange rates were introduced between 1960s and 1970s in which the local currency is pegged to the dollar. Again, the floating regime was introduced between 1980s and 1990s (Joale, 2011). Despite these measures, the exchange rate instability continued, and the South African Reserve Bank had to introduce inflation targeting and floating exchange rate policy in 2000. Although, this initially stabilized the exchange rate but after a while the instability continued.

Frankel (2007) explained that exchange rate in South Africa had lost about 15% of the real value due to Apartheid by 2003 and this has continued consistently despite the various modifications made to the exchange rate policies. The current exchange rate in South Africa is the flexible exchange rate which allows the determination of exchange rates through the forces of demand and supply and given the large volume of international market activities in South Africa, there has been large level of fluctuations in the exchange rate (Boateng, 2020).

This fluctuation in exchange rate has continued to receive widespread attention and despite the series of government interventions, regulations, and studies, it has continued to be a major treat to economic growth. Therefore, this study aimed to evaluate the impact of some macroeconomic variables like gross domestic product growth rate, interest rate and net foreign trade on exchange rate in South Africa and how government and policymakers could better manage exchange rate fluctuations.

Research Questions
The study provided answers to the following research questions:
  i.   What is the effect of gross domestic product growth rate on exchange rate in South Africa?
  ii. In what way does interest rate have impact on the exchange rate in South Africa?
  iii. What is the effect of net foreign trade on the exchange rate in South Africa?

Research Hypothesis
The following hypotheses were tested in order to achieve the objective:
H_{01}: There is no significant effect of gross domestic product growth rate on exchange rate in South Africa.
H_{02}: Interest rate has no significant effect on the exchange rate in South Africa
H_{03}: Net foreign trade does not have significant effect on the exchange rate in South Africa

Theoretical Review

Many researchers have used different theories to explain fluctuations in exchange rate. However, this study examined two theories of portfolio balanced approach and fisher effect.

The Portfolio Balanced Approach

This theory is an improvement to the money supply approach and according to Aslam, et al., (2020), portfolio balanced approach suggests that apart from monetary factors, holding of financial assets also affects the exchange rate. The approach introduced trade into the equation for determining exchange rate and considered bonds as an imperfect substitute. The theory presumes the equilibrium exchange rate between two countries is determined by the relative supply and demand of money and bonds.

Fisher Effect

This theory was first discussed by Fisher in 1930 to describe the relationship between interest rates, inflation and exchange rate. The theory explains fluctuations in exchange rates over time using interest rates instead of inflation rate differential. According to Cooray (2002), Fisher effect posited that the nominal interest rate in any period is equal to the sum of the real interest rate and the expected rate of inflation, and it suggests that nominal interest rates are unbiased indicators of future exchange rates.

Empirical Review

The study reviewed some of the existing literatures on how macroeconomic factors like interest rate, GDP growth and net foreign trade ratio, among others, affect exchange rates with a view to gaining better theoretical and empirical knowledge on the topic.

McPherson and Rakovski (2000) examined the association between exchange rate and GDP growth in Kenya using time series data from 1970 to 1996. The outcome of the co-integration revealed there was no evidence of a strong relationship between exchange rate and GDP growth. However, this result is not consistent with the findings of Abbas, et al., (2012) who investigated the relationship between gross domestic product, inflation and real interest rate with the exchange rate of 10 African countries using data from 1996 to 2010. The findings showed that GDP growth has significant relationship with the exchange while interest rate and inflation have no relationship with the exchange rates.

Fraiz and Fatima (2016) assessed the relationship between the gross domestic product growth, Inflation and interest rate with the exchange rate for some selected developed and developing countries. The authors obtained quarterly time series data and used OLS regression and Granger causality test for the data analysis. The results showed that GDP growth, inflation and interest rate have strong influence on the exchange rate for both the developed and developing countries.

Gente and León-Ledesma (2006) used panel data of 4 countries from 1980 to 2001 to investigate the factors of exchange rates and adopted Johansen cointegration method for estimation. The findings showed that increase in interest rates have a negative effect on the exchange rate. This outcome is consistent with the finding of Liew et al., (2009) who studied the association between exchange rates and its elements with monthly time series data from 1977 to 2006 and showed that interest rate and GDP have a negative effect on exchange rate in Thailand.

However, this does not align with the findings of Wong (2013) who assessed the relationship between exchange rate and economic growth in Malaysia using time series data from 1971 to 2008 with ARDL model for the analysis. The author showed that higher interest rates positively affect the home country currency. Also, Chowdhury and Hossain (2014) investigated the relationship between interest rate and exchange rate of Bangladesh and the outcome showed a positive association exists among interest rate and exchange rate in Bangladesh.

Ariccia (1998) conducted an analysis of exchange rate volatility on bilateral trade flows using gravity model and panel data of 14 European countries from 1975 to 1994. The author concluded that international trade has a negative effect on exchange rate. This result is not consistent with the findings of Bredin et al., (2003); Doyle (2004) and Kasman and Kasman (2005) who found positive impact of exchange rate volatility on trade.

Nicita (2013) examined the significance of exchange rates on international trade and how it could affect government decisions on trade policies. The author used fixed effects models on panel dataset obtained for 100 countries covering 2000 to 2009. The findings of the study showed that exchange rate volatility does not affect international trade except in the occurrence of currency unions and pegged exchange rates. This position confirms with the conclusion made by Bahmani et al., (1993) and Gagnon (1993) concluded that no significant relationship between exchange rate volatility and trade.

This study aimed to provide an improvement on existing related studies and test the conflicting findings as shown above in some of the literature reviewed with a view to filling any possible gaps by using gross domestic product growth rate, interest rate and evaluating their impact separately and collectively on exchange rate in South Africa.

METHODOLOGY

This study adopted secondary data from 1970 to 2021 consisting of 52 annual observations on exchange rate, gross domestic product growth rate, interest rate and ratio of net foreign trade. The data from world bank database website **https://data.worldbank.org/indicator.**

The multiple regression with OLS estimator was used to analyse the relationship between the dependent and independent variables. This technique was chosen because of its capacity to estimate the relationship between one dependent variable and two or more independent variables. The significance or otherwise of the specific or isolated and joint (aggregate) effects of gross domestic product, inflation rate and interest rate on exchange rate was determined using z-statistics and F-statistics and their associated probability values, at 5% level of significance.

In addition, White test, Breusch-Godfrey test and Variance Inflation Factor (VIF) were used to test the presence of heteroscedacity, autocorrelation and multicollinearity respectively.

In evaluating the relationship between the dependent and independent variables, this paper adopted the underlisted model.

$$ECR_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 INT_{it} + \beta_3 TRD_{it} + \mu_1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Model$$

Where:

ECR	= Exchange Rate Rand/Dollar
β_0	= Constant parameter/Intercept
$\beta_1 - \beta_3$	= Coefficients of the independent variables.
GDP	= Gross Domestic Product growth rate
INT	= Interest Rate
TRD	= Net Foreign Trade (% of export to import)
t	= Number of period
μ	= Error term; which measure the probability of statistical error encountered.

Data Analysis and Interpretation
Summary of OLS Output

```
******************* Linear Regression Output *********************************
                          OLS Regression Results
==============================================================================
Dep. Variable:                    ECR   R-squared:                       0.186
Model:                            OLS   Adj. R-squared:                  0.135
Method:                 Least Squares   F-statistic:                     4.262
Date:                Mon, 09 Jan 2023   Prob (F-statistic):            0.00953
Time:                        23:21:56   Log-Likelihood:                -147.30
No. Observations:                  52   AIC:                             302.6
Df Residuals:                      48   BIC:                             310.4
Df Model:                           3
Covariance Type:                  HAC
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept     12.5194      4.263      2.937      0.003       4.164      20.875
GDP           -0.4943      0.315     -1.569      0.117      -1.112       0.123
INT            0.1430      0.134      1.065      0.287      -0.120       0.406
TRD           -0.0569      0.030     -1.924      0.054      -0.115       0.001
==============================================================================
Omnibus:                        5.464   Durbin-Watson:                   0.189
Prob(Omnibus):                  0.065   Jarque-Bera (JB):                4.971
Skew:                           0.757   Prob(JB):                       0.0833
Kurtosis:                       3.054   Cond. No.                         763.
==============================================================================

Notes:
[1] Standard Errors are heteroscedasticity and autocorrelation robust (HAC) using 1 lags and with small
on/SA OLS ESTIMATOR.ipynb#  ***********************************************
```

Source: Researcher's study (2023)

From the OLS output above, the R-squared showed 0.186 which means 18.6% of the variation in exchange rate is explained by factors of gross domestic product, interest rate and net foreign trade while the remaining 81.4% is explained by other factors not in the model.

The Durbin-Watson figure is 0.189 is less than 1 and could mean the presence of autocorrelation. Autocorrelation was tested using Breusch-Godfrey test and it was found that the p-value was less than 0.05 which means we reject Null which states no autocorrelation. However, this was corrected using the Newey West Robust Standard Errors.

Results of Autocorrelation

```
-------------------------------BG Test-------------------------------------
[('LM Stat', 42.64030991660128), ('pvalue', 6.578953503227585e-11), ('f-value', 214.11975698158255), ('f pvalue', 4.01156215709
56774e-19)]
------------------------------- End of BG Test-------------------------------------
```

Researcher's study (2023)

Also, test for heteroscadicity was carried out using the White test and the result showed there was none. The p-value was greater than 0.05 which means we cannot reject Null which states no heteroscedacity.

Result of Heteroscedacity

```
6.45637389705091e-15
-------------------------------White Test-------------------------------------
[('LM Stat', 13.377862879318712), ('pvalue', 0.14624040459586188), ('f-value', 1.6164311823315478), ('f pvalue', 0.141830026075
7544)]
------------------------------- End of White Test-------------------------------------
```

Researcher's study (2023)

Again, test for multicollinearity was conducted using the Variance Inflation Factor (VIF) and the result showed that none of the VIF figures are greater than 5 which suggest there was no evidence of multicollinearity.

Result of Multicollinearity

```
#view VIF for each predictor variable
print(vif_df)

     variable          VIF
0   Intercept    44.343407
1         GDP     1.127133
2         IFR     1.463265
3         INT     1.393980
4         TRD     1.676337
```

Researcher's study (2023)

Interpretation of results

The Model is given as:

$ECR_{it} = 12.519 - 0.494GDP_{it} + 0.143INT_{it} - 0.057TRD_{it}$

The result of the regression showed gross domestic product has negative insignificant relationship with exchange rate. The co-efficient showed a negative figure of 0.494 and p-value of 0.117 which is greater than 0.05 significance level. This implies that gross domestic product is not a significant factor influencing changes in exchange rate and so we fail to reject the null hypothesis (H_{01}). Although the sign agrees with the priori expectation, but the significance level does not. This shows that any 1% increase in GDP growth rate will cause the local currency to strengthen by 0.494% thereby causing the exchange rate to reduce and vice versa, though this is not significant.

This result is consistent with the findings of Azid et al., (2005) and McPherson and Rakovski (2000) that no evidence of strong relationship exists between GDP and exchange rate. However, this is contrary to the conclusion of Abbas, et al., (2012) that GDP growth has significant relationship with the exchange rate.

Interest rate has positive insignificant relationship with exchange rate. The co-efficients showed a positive figure of 0.143 with p-value of 0.287 which are higher than 0.05 significance level. This implies that interest rate is not a significant factor influencing changes in exchange rate and so we fail to reject the null hypothesis (H_{02}). The result means that any 1% increase in interest rate will cause the local currency to drop by 0.143% which will in turn cause the exchange rate to increase, though this is not significant. Although the sign relates to the a priori expectation but the significance does not. The outcome aligns with the findings of Abdoh, et al., (2016) that inflation and interest rate do not have significant impact on the exchange rate and inconsistent with the conclusion by Wong (2013) that higher interest rates positively affect the home country currency.

Net foreign trade has negative insignificant relationship with exchange rate. The co-efficients showed a negative figure of 0.057 with p-value of 0.054 which is greater than 0.05 significance level. This means that net foreign trade is not a significant factor causing changes in exchange rate and as such we fail to reject the null hypothesis (H_{03}). This means if the ratio of net foreign trade increase by 1% the local currency will rise by 0.054% thereby causing the exchange rate to reduce, though this is not significant.

This finding conforms with the conclusion in Bahmani et al., (1993) and Gagnon (1993) that no significant relationship exists between exchange rate volatility and trade but not consistent with the findings of Bredin et al., (2003) and Doyle (2001) that positive significant relationship exists between exchange rate and trade.

Test of Joint Significance

The *F*- Test which measures joint significance of the variables showed f-statistics value of 4.262 with a probability value of 0.00953 which is less than 0.05 which means all the independent variables have joint significant relationship with exchange rate. Even though they do not have individual significant relationship with exchange rate, but their combine effect has significant influence on exchange rate. This conforms with the findings by Fraiz and Fatima (2016) that GDP growth, inflation and interest rate have strong influence on the exchange rate.

CONCLUSION AND RECOMMENDATIONS

This study examined the impact of macroeconomics variables like gross domestic product growth rate, interest rate and net foreign trade on exchange rate for the South African Rand. The linear regression model with OLS estimator was adopted in evaluating this impact using annual secondary data for 52 years. The result of the regression showed that interest rate has positive relationship with exchange rate while gross domestic product growth rate and net foreign trade have negative relationship, although these individual relationships are not significant enough to cause changes in exchange rate as shown by the p-values of their z-scores which are greater than 0.05. As a result, we failed to reject the Null hypothesis (H_{01}, H_{02} & H_{03}). However, the f-statistics gave a p-value of 0.00953 which is less than 0.05, an indication that joint significant relationship exist between the independent variables and the dependent variable which means the combine effect of the variables will have significant influence on exchange rate.

The South African Reserve Bank (SARB) should continue to review and re-access the exchange rate policies and enhance the FX, interest rate and market risk management in the country. Also, the government and policy makers in South Africa should step up the monitoring process on interest rate, gross domestic products and trade transactions to ensure their combined effect does not adversely affect the exchange rate. The government should focus on the growth of productivity in the country and come up with policies to encourage more of international trade, especially exports. This will help to strengthen the local currency, as shown by the study.

Suggestion for Further Studies

These results of the study conform with some of the previous findings while also coming inconsistent with some previous conclusions. Therefore, further studies can still be undertaken to explore the conflicting outcomes.

REFERENCES

Abbas, Q., Iqbal, J. and Ayaz, L. (2012). Relationship between GDP, inflation and real interest rate with exchange rate fluctuation of African Countries. *International Journal of Academic Research in Accounting, Finance and Management Sciences,* 2(3), 132-141.

Ariccia, G. D. (1999). Exchange rate fluctuations and trade flows. *Evidence from the European Union," IMF Staff Papers, Palgrave Macmillan,* 46(3), 1-5.

Aslam, F., Aziz, S., Nguyen, D. K., Mughal, K. S. and Khan M. (2020). On the efficiency of foreign exchange markets in times of the COVID-19 pandemic. *Technological Forecasting and Social Change*, 161.

Azid T., Jamil, M., Kousar A. and Kemal, M. A. (2005). Impact of exchange rate volatility on growth and economic performance: a case study of Pakistan 1973-2003. *Pakistan Society of Development Economics,* 44(4), 749-775.

Bahmani, O. M. (1991). Exchange rate unceetainty and trade flows of developing countries. *The Journal of Developing Areas,* 25(4), 497-508.

Boateng, A., Claudio-Quiroga, G. and Gil-Alana, L. (2020). Exchange rate dynamics in South Africa. *Applied Economics*, 52:22, 2339-2352.

Chowdhury, M. and Hossain, M. T. (2014). Determinants of exchange rate in Bangladesh: A case study. *Journal of Economics and Sustainable Development*, 5(1)

Cooray, A. (2002). The Fisher Effect: A survey. *The Singapore Economic Review*, 48 (2), 135–150.

Doyle, E. (2004). Exchange rate pass -through in a small open economy: *The Anglo-Irish case* . *Applied Economics*, 36, 443-455.

Edison, H. and Pauls, B.D. (1993). A reassessment of the relationship between real exchange rate and real interest rate . *Journal of Monetary Economics,* 31, 165-187.

Frankel, J. (2007). On the Rand: determinants of the South African exchange rate. CID Working Paper No. 139. Center for International Development at Harvard University.

Fraz, T. R. and Fatima, S. (2016). Exploring the impact of macro economic variables on exchange rate: A Case of some developed and developing countries . *Pakistan Journal of Applied Economics,* Special Issue, 299-315.

Gagnon, J. E. (1993). Exchange rate variability and the level of international trade. *Journal of International Economics*, 34(3), 269-287.

Gente, K. and Leon-Ledesma, M. (2004). Does the world real interest rate affect the real exchange rate? . The South East Asian Experience, Studies in Economics, School of Economics, University of Kent.

Joale, D. (2011). Analyzing the effect of exchange rate volatility on South Africa's exports to the U.S . Theory and Evidence .

Kasman, A. and Kasman, S. (2005). Exchange rate uncertainty in Turkey and its impact on export volume. *Open Economies Review* 12 (4), 424-434.

Khan, M.K., Teng, J. Z. and Khan, M.I. (2019). Cointegration between macroeconomic factors and the exchange rate USD/CNY . *Financial Innovator*, 5(5).

Liew, V., ian-Ping, L. & Huzaimi, H. (2003). Exchange rate and trade balance relationship: The experience of ASEAN countries. International Trade, University Library of Munich, Germany.

Madura, J. (2006). Exchange rate determination. International Corporate Finance. Thomson/South-Western .

Mcpherson, M. & Rakovski, T. (1998). Exchange rates and economic growth in Kenya: An econometric analysis . Harvard - Institute for International Development, Papers.

Mirchandani, A. (2013). Analysis of macroeconomic determinants of exchange rate volatility in India. *International Journal of Economics and Financial Issues*, 3(1), 172-179.

Mtonga, E. (2013). Did it matter? monetary policy regime change and exchange rate dynamics in South Africa. Scientific Figure on ResearchGate.

Wong, Y. M. (2013). Foreign exchange market efficiency . Asia-Pacific focus / Wong Yuen Meng. PhD thesis, University of Malaya.