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The Impact of Oil Prices on the Trade Balance of South Africa

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Abstract: The study investigate the relationship between crude oil prices and the trade balance of South Africa using the Autoregressive Distributed Lag model. The bounds cointegration test was employed to determine the long-run relationship between oil prices and the trade balance of South Africa. The results prove that there is one cointegration vector between the trade balance and real oil prices, real exchange rate, domestic income, real interest rate and the inflation rate. Our results provide evidence that oil price changes have a significant and negative impact on the balance of trade. The negative sign and significance of the Error Correction Term and diagnostic tests have approved the reliability of the results.

Keywords: Oil price; trade balance; Autoregressive Distributed Lag

JEL Classification: P45

Introduction and Background

The trade balance is an important macroeconomic variable to ensure that there is sustainable economic growth. The sustainability of high economic growth and macroeconomic stability is affected by the increasing trade deficits. Thus, the behaviour of the trade balance influences the current account and the balance of payments of a country. Increasing trade deficits lead to increased indebtedness that could open South Africa to be more vulnerable to external shocks. The apparent increases in the trade deficit have taken place under the circumstances of increasing import growth in excess of exports. In 2012, imports grew by 15% and exports grew by 4% (South African Reserve Bank [SARB], 2016). The weakness in export growth is a contributing factor to the growth of trade and the current account deficits.

The South African government has initiated various export incentives to encourage export growth in response to worsening trade deficits. Despite these measures, exports have shown signs of improvement but the speed has not been sufficient to ensure export development. The National Treasury (2008) introduced strategies to reduce the trade deficit, through the reduction of tariff barriers in order to increase the competitiveness of the domestic economy, the liberalisation of exchange controls in order to deepen capital markets and efforts to increase and diversify exports. Regardless, of the implementation of these strategies the country is still functioning at significantly high trade deficits. Some authors have associated that the increased deficits to high oil prices such as Hassan and Zaman (2012) and Bao (2014).

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Oil forms part of the most internationally traded commodity and the instability of oil prices could influence the occurrence of large trade imbalances globally. (Le & Chang, 2013) Higher oil prices for an oil importing country causes a reduction in export growth due to increased production costs and production falls. Ziramba (2010) mentions that about 95% of the country's crude oil demands are satisfied by oil imports since the country has limited oil reserves and must depend on oil imports to satisfy its energy necessities. The dependence on crude oil imports makes crude oil the country's largest import item and South Africa imports about 6% of its crude oil (Energy Information Administration [EIA], (2015).

Previous scholars, such as Nkomo (2006) have indicated that high oil prices lead to income transfer from oil-consuming to oil- producing countries, increase inflation rate, increase input and transport cost and decline investment in the economy. As a result, the World Trade Organization [WTO] (2013) suggest that the impact of changes in oil prices on the economy is determined by the degree of dependence and the oil price elasticity of demand. Fattouh (2007) expands that high oil prices can slow economic growth, cause inflationary pressures and create global imbalances, hence some countries are opting to devalue their currencies in order to grow their exports in excess of imports and improve their trade balance.

The WTO (2013) mentions that there has been a substantial expansion in international trade due to reductions in trade barriers, transportation costs, policy barriers and internal trade and transaction costs. Parikh and Stirbu (2004) reasons that many developing countries have trade policies that ensure openness on per capita income growth, which tends to increase imports in excess of exports and improves trade deficits and cause low economic growth. However, there are benefits and drawbacks associated with high dependence on trade such as improved economic efficiency and on the other hand, worsen the trade deficit that ultimately impedes economic growth. In addition, increasing oil prices, exchange rate appreciation and low economic growth could also be contributing factors to increased trade deficits. Bahmani-Oskooee (1998) had recommended that an important macroeconomic policy to reduce the trade deficit was devaluation. However, several countries are sceptical to depreciate their currencies to recover the balance of trade.

Aloui, Nguyeh and Njeh (2012) indicates that policymakers and investors usually scrutinise oil price fluctuations, as they are essential to ensure economic and industrial activity. The study aims to determine the long-run relationship between crude oil prices and the balance of trade of South Africa. The study will contribute by providing an understanding about the influence oil prices might have on the trade deficit, the determinants of the balance of trade and methods to ensure competitiveness and the reduction of the trade deficit.

Theoretical and Empirical Literature

The study uses the trade transmission channel to explain the impact oil prices have on the trade balance of South Africa.

Kilian, Rebicci and Spatafora (2009) and Le and Chang (2013) suggest that oil price influences on the trade balance could be studied through the trade and financial channel. According to Adam et al., (2015), the trade channel works through changes in quantities and prices of tradable goods while the financial

channel works through changes in external portfolio positions and asset prices. The focus will be on the trade channel and will deliberate on the mechanisms that predict that oil prices determine the trade balances. According to Bao (2014), the effectiveness of the trade transmission channel rests on the economic development level of the country, the status as developing or developed country and the role as an oil-producing or oil-consuming country.

Theoretically, fluctuations in oil prices are indirectly transmitted to international trade, whereas has a direct influence on inflation, output and economic growth. Such that for an oil-consuming country, an external surge in oil prices could have an undesirable impact on the trade balance. (Le & Chang, 2013) As oil is considered to be, an input into the production process increases in oil prices could lead to an increase in input costs and real gross domestic product falls. This might induce firms to decline their expenditure and investment plans, producers to reduce their production levels and their exports; however, the country may not similarly decrease its consumption of imported merchandise. Thus, an exogenous oil price increase is expected to have a negative effect on the balance of trade.

Empirical Literature

This section provides a review of the empirical evidence from both international and domestic literature:

Adam et al., (2015) examined the dynamics of the association between oil prices and Indonesia's balance of trade by using Linear VAR. They concluded that there is a statistically significant and negative relationship between West Taxes Intermediate crude oil prices and the trade balance. The finding implies that a surge in the price of oil will result in a fall in the trade balance of Indonesia.

Bao (2014) implemented the Autoregressive Distributed lag (ARDL) approach to analyse the effects and causal association between oil price shocks and the trade balance of Vietnam. Similarly, Hassan and Zaman (2012) observed the presence of a long-run relationship between the trade balance, oil prices and macro factors. There is evidence that there is a negative association amongst oil prices and the trade balance, where a 1% increase in world oil prices would result in a significant reduction of 0.12% in Vietnam's trade balance. The REER finding was in contradiction with theory since the variable is negative and statistically significant in explaining the trade balance. In other words, a 1% increase in REER would cause the trade balance to decrease by 0.79%, whereas, output gap was positive and had no significant impact on the trade balance.

Arouri, Tiwari & Teulon (2014) explored the possibility of oil price shocks in causing large trade imbalances in India using the frequency domain to make the Granger-causality analysis. They found that the variables Granger-caused each other in both the short and long-run frequency horizons. However, more strength is found when causality is running from oil prices to the trade balance and they proved that oil prices have become a leading indicator for India's trade balance in the short to the medium and long horizon.

Le and Chang (2013) employed the Vector Autoregressive (VAR) approach for Japan (oil- importer), Malaysia (oil exporter) and Singapore (oil-refinery), in order, to determine a linkage between the variability of trade imbalances and the movements in global oil prices. They found that for Japan oil prices Granger-cause the oil and nonoil trade balance, of which, there is no causality with the overall

trade balance. In Malaysia, oil prices seem to Granger-cause the balance of trade and the oil trade balance, in contrast, for Singapore, there is no sign of causality as increasing oil prices would have both negative and positive effects for their economy. As a result, their oil import bill would increase and their oil refinery exports revenue increased.

Fofana, Chitinga and Mabugu (2009) evaluated the distributional impacts of higher oil prices on the economy by, analysing the macro-economic, meso-economic and micro-economic level and the household survey and the input-output data set was used. They believed that if the elasticity for oil and oil merchandises were zero, a price rise would subsequently result in a corresponding increase in the oil import bill as the quantities imported remain unchanged. As a result, this increase signifies a significant shift in the import structure and the trade figures, and so, the increase will lead to imports being somewhat more expensive, exports deteriorate and real national income falls. They concluded that rich households spent more on transport fuel than their poor counterparts and that the transport sector and primary plastic industries are mostly affected by higher oil prices as compared to other sectors. They mentioned that the South African economy will not be significantly affected by higher oil and oil product prices since the country has large coal reserves and a developed synthetic industry that is used as alternative energy sources to protect the economy from volatile global oil prices.

Chen and Chen (2007) studied G7 countries to distinguish the connection between real oil prices and real exchange rate using panel data analysis. Their findings confirm that there is cointegration between the real exchange rate and real oil prices and that an increase in real oil prices will depreciate the real exchange rate. Similarly, Ghosh (2011) found that the Indian currency in relation to the US dollar depreciated by 0.14% because of a 10% surge in oil prices. The depreciation of the currency is driven by excess procument of US currency to pay for the more expensive oil caused by escalating global oil prices.

Brown and Yucel (2002) surveyed the theory and evidence linking fluctuations in energy prices to aggregate economic activity. Hence, theoretical evidence proved that there is a link between higher oil prices and GDP losses. Whereas, the supply-side effect is the most effective in clarifying that higher oil prices result in low GDP growth and rising inflation. This is caused by the fact that increasing oil prices are indicative of the reduced availability of a basic input into production. The concept of asymmetric effects was supported by the study as rising oil prices tended to decrease economic activity by more than falling oil prices increased it.

Kennedy (2013) investigated the major determinants of the trade balance in Kenya using the Johansen cointegration and Error Correction Model (ECM). The researcher established a long-run association amongst the trade balance, exchange rate, budget deficit and foreign direct investment (FDI). Where the exchange rate is statistically significant and positively related to the trade balance, this means that depreciation would result in an improvement in the balance of trade. In addition, an increase in the inflow of FDI would result in an improvement of the balance of trade, since this would encourage investors to upsurge the production of domestic substitutes to imports. However, the budget deficit is positively related to the trade balance, but, insignificant and this is in support of the belief that an increase in the trade deficit is caused by an increase in government budget deficit.

Shawa and Shen (2013) analysed the main determinants of the trade balance in Tanzania using the OLS. Contrarily, to Kennedy (2013) they establish that the real exchange rate devaluation had no impact on

improving Tanzania's exports, since, the variable was negative and insignificant. They established that the major determinants of the trade balance in Tanzania were FDI, human capital development, household consumption expenditure, government expenditure, inflation and natural resource availability and foreign income. The dummy variable trade liberalization is positive and significant, however, in reality, this is not feasible given the widening trade deficit.

Bash (2015) used the Variance Autoregressive and Ordinary Least Squares (OLS) method to identify the impact oil prices fluctuations have on Jordanian public budget. The author found that there is a one-way directional causal relationship from crude oil prices to the Jordanian public deficit. He proved that oil price fluctuations have a positive and significant influence on the public budget deficit of Jordan, hence, an increase in crude oil prices would result in a rise in the public budget deficit of Jordan. Furthermore, recommended that the Jordanian economy should deal with technical and economic problems stemming from the crude oil sector and utilise the latest technology to improve its contribution to GDP growth. Similarly, the International Energy Agency [IEA] (2004) discovered that higher oil prices result in worsening the budget deficit, reduce GDP and deteriorate the trade balance for oil-importing developing countries.

Schaling and Kabundi (2014) used the Vector Error Correction Model (VECM) to approve the existence of a long-run equilibrium association between the balance of trade, domestic income, REER and foreign income. Where they found that a 1% increase in RGDP related to growth in the demand for imported goods and services results in a 1.38% fall in the trade balance. Likewise, an increase in foreign economic activity measured by the US GDP improves the trade balance through encouraging exports from the country to the rest world. Thus, a depreciation would likely improve exports and slow down imports, of the thereby, improving the trade balance. They indicated that a weaker rand has adverse pass-through effects on inflation, however, this could somehow be counterbalanced by an improvement in the trade balance and increasing South Africa's GDP. The short-run results show that SA GDP and US GDP are insignificant, nevertheless, the REER is significant and positive in explaining the trade balance. The J-curve hypothesis is accepted since 1% depreciation worsens the trade balance by 0.19%.

Methodology

Data Sources

The data was extracted from the U.S Energy Information Administration (EIA) and the South African Reserve Bank (SARB). To ensure that the study uses real variables we used the ratio of export merchandise to import merchandise (TB). The ratio expression allows the variable to be in logarithmic form, be able to measure the rate of change, not be sensitive to units of measurement and be shown in nominal or real terms. (Bahmani-Oskooee & Brooks, 1999) The study uses real Brent crude oil prices (OP) that are expressed using the U.S currency (USD/bbl), the real effective exchange rate (REER), domestic incomes (Y) which is measured using a proxy real gross domestic product, domestic price level (CPI) and the real interest rate (RIR). There is an expectation that real oil prices could, likewise, be negatively related to the trade balance as discovered by Hassan and Zaman (2012).

Estimation Technique

The study adopts a similar model that was implemented by Bao (2014). The study uses the Autoregressive Distributed Lag (ARDL) approach as introduced by Pesaran, Shin and Smith (2001). The technique does not necessitate pre-testing of the order of integration of the explanatory variables, uses an unrestricted error correction model (ECM) and it is applicable to small samples. The ARDL model is broken down into three steps to test the trade balance model.

The initial step is to determine the existence of a long-run relationship between the variables. The existence of a long-run relationship is proven by the significance of lagged variables using the F-test and the reduced trade balance model is expressed below as follows:

Equation 1. Long-run ARDL

$$TB_t = \alpha_0 + \beta_1 \ Log\, TB_{t-1} + \beta_2 Log\, OP_{t-1} + \beta_3\, REER_{t-1} + \beta_4 Log\, Y_{t-1} + \beta_5 CPI_{t-1} + \beta_6 \ Log\, RIR_{t-1} + \mu_{t-1}$$

The bounds testing approach aims to determine that jointly the variables are cointegrated with the trade balance. The test is based on the null hypothesis of no cointegration, where all the lagged coefficients are confined to zero and against an alternative hypothesis of the existence of cointegration. Whereas the null hypothesis is rejected when the cointegration of the variables is confirmed. However, this is done through two asymptotic critical value bounds that are used to test the null hypothesis. The null is rejected when the F-statistic is greater than the upper bound which is *I*(1) and we fail to reject the null if the F-statistic is lower than the lower bound then it is *I*(0).

Table 1. Cointegration test: Bound test

F-statistics	L0 Bound	L1 Bound
5.495855*	2.62	3.79

*Null hypothesis of no cointegration, *5% significance level*

Error! Reference source not found. Error! Reference source not found. show that at the 5% significance level the null of no cointegration has been rejected as the existence of one cointegrating vector has been confirmed. The study proves that there is cointegration between the trade balance and the independent variables. Secondly, after cointegration has been confirmed it becomes important to choose the optimal number of lags to use in the model using the information criterions as suggested by Pesaran et al. (2001).

Table 2. Lag selection criteria: Akaike Information Criterion (AIC)

Dependent Variables	LTB	LOP	LY	REER	RIR	CPI
Significant Lags	2	7	7	6	5	3

The existence of a long-run relationship forces us to choose the appropriate lag length for the model using the Akaike Information Criterion. In **Error! Reference source not found.**, the AIC has chosen 8 lag lengths and the optimum number of lags used in the ARDL trade model is 2, 7, 7, 6, 5, and 3.

The model above suggest that the trade balance is explained by the lags of its self, current and lagged values of a number of explanatory variables. The next step is to use the Error correction model to determine the sort and long-run relationship using the model below:

Equation 2. ARDL-ECM model

$$\Delta TB_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 \Delta \, log\, TB_{t-i} + \sum_{i=0}^{p} \alpha_2 \Delta \, LOG\, OP_{t-i} + \sum_{i=0}^{p} \alpha_3 \Delta REER_{t-i} + \sum_{i=0}^{p} \alpha_4 \Delta \, Log\, Y_{t-i} + \sum_{i=0}^{p} \alpha_5 \Delta CPI_{t-i} + \sum_{i=0}^{p} \alpha_6 \; \Delta \; Log\, RIR_{t-i} + \beta_1 \, Log\, TB_{t-1} + \beta_2 Log\, OP_{t-1} + \beta_3 \, REER_{t-1} + \beta_4 Log\, Y_{t-1} + \beta_5 CPI_{t-1} + \; \beta_6 \; Log\, RIR_{t-1} + \mu_{t-1}$$

Where, the α_i coefficients represent the short-run elasticities and β_i parameters represent the long-run relationship in the model. The relevance of the variables included in the model will be proven by the negative and significant value of the Error Correction Term (ECT).

Estimation

ARDL

The unit root test result shows that the variables are either *I*(0) or *I*(1). As a result, the ADF[1] and PP stationarity test results show that none of the variables in the trade balance model are *I*(2). Equation$TBt = \alpha_0 + \beta_1 \; Log\, TB_{t-1} + \beta_2 Log\, OP_{t-1} + \beta_3 \, REER_{t-1} + \beta_4 Log\, Y_{t-1} + \beta_5 CPI_{t-1} + \; \beta_6 \; Log\, RIR_{t-1} + \mu_{t-1}$ results show that the long-run trade balance model indicates that all the independent variables are statistically significant in explaining the trade balance.

Table 3. ARDL regression results

Dependent Variable: LTB				
Variable	**Coefficient**	**Stand Error**	**t-Statistics**	**Prob.***
LTB(-1)	0.286970	0.115925	2.475482	0.0161
LTB(-2)	0.417351	0.106103	3.933457	0.0002
LOP(-7)	-0.143840	0.039037	-3.684765	0.0005
LRIR(-2)	0.507578	0.162699	3.119745	0.0028
LRIR(-5)	0.209797	0.098899	2.121333	0.0380
REER(-4)	0.002947	0.001062	2.773798	0.0073
LY	2.104374	1.020064	2.062983	0.0434
LY(-7)	2.385704	0.953889	2.501029	0.0151
CPI	0.003896	0.001647	2.365299	0.0212
CPI(-1)	-0.004468	0.002010	-2.222972	0.0299
CPI(-2)	0.006048	0.002336	2.589042	0.0120
R-Squared 0.825403 Adjusted R-squared 0.725225 F-statistic 8.239342 Prob (F-statistic) 0.000000				

A 1% surge in real oil prices results in a 0.14% deterioration in the trade balance of South Africa and this implies that oil prices increases have a negative impact on the trade balance. The real interest rate and real effective exchange rate are positive thus the Marshall-Lerner condition holds as devaluation improves the trade balance in the long-run. The positive association between the trade balance and

[1] Results are available on request.

domestic income is in contravention with economic theory as the findings suggest that demand for domestically produced goods increase.

Long-Run Elasticities

The β_i parameters of equation (3) are shown on the table **Error! Reference source not found.** as the ECM long-run empirical results for the trade balance model.

Table 4. Long-run trade elasticity

Dependent Variable: Trade Balance				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LOP	-0.250066*	0.109021	-2.293735	0.0253
LRIR	0.417874	0.295895	1.412239	0.1630
REER	0.003563	0.009645	0.369467	0.7131
LY	0.845007*	0.293707	2.877039	0.0055
CPI	0.027659*	0.012139	2.278585	0.0262

The results show that the trade balance is determined by oil prices, domestic income and the consumer price index. In the long-run, changes in the price of crude oil had a deteriorating effect on the trade balance by 0.25%, whereas an increase in domestic income had a positive effect of 0.84% on the trade balance. In addition, the trade balance rises by 0.02% because of a 1% increase in the inflation rate.

Short-Run Elasticities

There is evidence that all the explanatory variables have a significant impact on the trade balance. In the short-run, the real oil prices have a positive impact on the trade balance meaning that as real oil price increase the trade balance improves into a surplus. A devaluation of the currency has a positive impact on the trade balance, as Edwards and Lawrence (2008) had mentioned that devaluation of the REER can either improve or worsen the trade balance depending on trade elasticities. The real interest rate, domestic income and inflation are all negatively related to the trade balance.

Table 5. Short-run trade elasticity

Tabulation of the Error Correction Model results				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LTB(-1))	-0.417351	0.093918	-4.443770	0.0000
D(LOP(-5))	0.115256	0.033114	3.480631	0.0009
D(LOP(-6))	0.143840	0.035252	4.080374	0.0001
D(LRIR(-1))	-0.397687	0.088677	-4.484684	0.0000
D(LRIR(-4))	-0.209797	0.094442	-2.221433	0.0300
D(REER(-4))	0.003594	0.001133	3.172600	0.0024
D(LY)	2.104374	0.899539	2.339391	0.0226
D(LY(-3))	-2.670523	0.965663	-2.765482	0.0075
D(LY(-6))	-2.385704	0.875473	-2.725045	0.0084
D(CPI)	0.003896	0.001511	2.578240	0.0124
D(CPI(-1))	-0.008750	0.001587	-5.512734	0.0000
C	-3.986785	0.667563	-5.972150	0.0000
CointEq(-1)	-0.295678	0.049502	-5.973107	0.0000
Cointeq = LTB - (-0.2501*LOP + 0.4179*LINT + 0.0036*RER + 0.8450 *LRGDP+ 0.0277*CPI)				

The ECT is statistically significant and has the appropriate sign, implying that roughly 29% of the deviation from the equilibrium would be corrected in the next quarter. Moreover, the significance of the ECT confirms the existence of a long-run relationship between the variables.

Diagnostic Test

The tests validates that the attained results are statistically significant and have the correct sign by testing for the presence of heteroscedasticity (LM test), autocorrelation (LM test) and normality (Jarque-Bera test). The diagnostic test results indicate that the estimated trade balance model does not suffer from unequal variance, serial correlation and non-normality.

Table 6. Diagnostic test

Test	Hypothesis	t-Statistic	Probability
Breusch-Pagan-Godfrey	Errors are not heteroscedastic	41.04620	0.2226
Breusch-Godfrey Serial Correlation LM Test	There is no serial correlation	0.110668	0.9462
Jarque-Bera	Normal distribution	2.654424	0.265216

The CUSUM (Cumulative Sum) and CUSUM of Square (CUSUMSQ) tested the null of parameter stability of the model. The results presented in **Error! Reference source not found.** display that the parameters are stable over the sample period since they remain within the 95% critical bound. The validity, soundness and robustness of the results are confirmed by the diagnostic test.

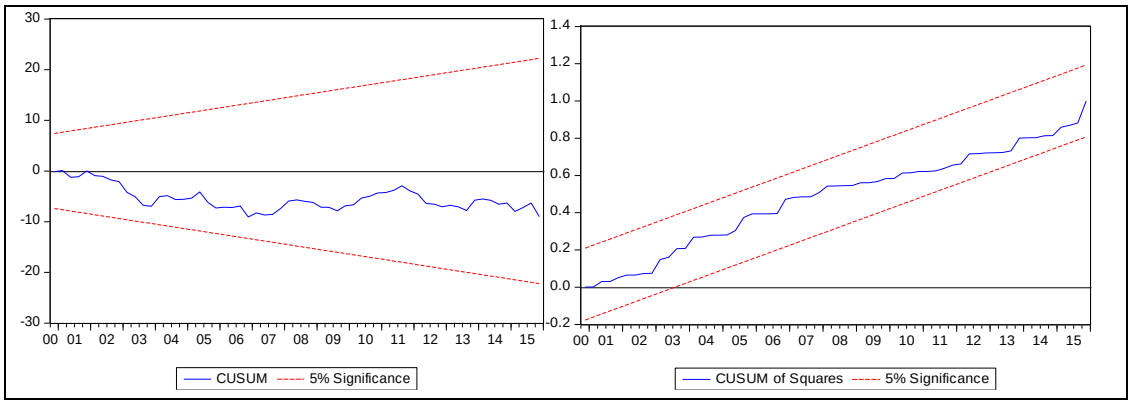

Figure 1. Stability test: CUSUM & CUSUM of Square

Conclusion and Policy Recommendations

The study examined oil prices as a determinant of the trade balance of the country with the use of the ARDL-ECM technique. The study is based on the view that export growth is the driver in ensuring export competitiveness, economic growth and most importantly enhancing the trade balance. The study's empirical foundation is that there is evidence that oil price changes have an influence on the trade balance and the depreciation of the currency. The ARDL approach was used since it provides unbiased estimators and the ECM approved the validity of the results. The bounds test found that the trade balance model had one cointegrating vector, implying that between the variables a long-run relationship existed.

The trade balance model results indicate that changes in oil prices are the resulting cause of the trade imbalance in South Africa. This finding is supported by Hassan and Zaman (2012); Bao (2014); Adam et al. (2015) for their respective countries as they found that oil prices have a negative impact on the trade balance. The exchange rate is positive and a significant determinant, implying that currency devaluation improves the trade balance. This finding is aligned with empirical evidence because of devaluations, exports have become competitive and imports became relatively costly. The positive association between real interest rate and the trade balance suggest that individuals are encouraged to save more rather than buying imported goods. The findings for both the trade balance model and the short-run show that domestic prices are negatively related to the country's trade balance, implying that domestically produced goods are ultimately expensive.

The study has reached to making various recommendations based on the findings. Firstly, there is a need for government and businesses to increase domestic and continental investment and reinforce regional integration by trading more with oil suppliers in the African region. This would ensure development in the region and avoid uncertainty in oil prices caused by political instability in the Middle East. Furthermore, there is a need for sectors to invest in research and development so that they can establish new advanced substitutes for oil as new alternative source would be used as inputs into their production activities. In the meantime, the government has executed diverse export incentives, liberalised exchange controls and diversified exports, nonetheless, neither have encouraged exports growth in excess of imports. Therefore, it becomes crucial to examine the impact trade liberalisation has on encouraging export growth over imports. In addition, the focus of monetary authorities is stabilising domestic prices whereas the exchange rate is floating and it becomes essential that authorities have to reinforce control in the inflation rate and ensure that the rate is always within the target band irrespective of increasing oil prices. Finally, the use of the devaluation policy is recommended to ensure the improvement of the balance of trade, as the results indicate that it has positive effects in both the long and short-run.

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