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Revisiting the Effect of Exchange Rates on Imports and Exports in South Africa.

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Abstract: South African economic growth relies hardly on the export of goods and services. Meanwhile, imports are also part of the economic development package. Both imports and exports form part of the balance of payment equilibrium again it's used to calculate terms of trade that could affect and be affected by the exchange rates. The study investigates the effect of exchange rates, economic growth and inflation on imports and exports via the ADF cointegration approach to detect the existence of the equilibrium in the aforementioned variables. The secondary data stretched from 1994Q1 to 2021Q4 was employed. Furthermore, the terms of trade were included in the process, to explore the nexus between the terms of trade, economic growth, exchange rates and inflation via the VAR model. The study findings confirmed that the terms of trade have a significant impact on exchange rates. The latter pass-through affects inflation rates while growth is not highly affected by terms of trade but negatively affected by inflation and exchange rates. The study argues that policymakers to accelerate the volume of exports via the labour-intensive sectors to curb the high unemployment, reduce the trade deficit and accelerate growth.

Keywords: Cointegration; imports; exports; VAR model

JEL Classification: E430

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1. Introduction

Despite being an economic powerhouse, with a well-established monetary policy and a gate to Africa, the South African economy remains highly competitive in the world. Some of the cornerstones for growth in South Africa are imports and exports that equally form the terms of trade. South Africa is eminent for its voluminous export of Gold and other precious metals including natural resources such as coal and other agricultural activities. Beyond the gravity model, the volume of import welcomes new product that does not exist in the economy such as oil product. South Africa and other African states share technological instruments in the form of the fourth industrial revolution in line with the current educational system. Due to the availability of imports largely from other fellow emerging markets that share a similar vision for growth in the future. For example, the everyday lives of South Africans remain intact with electrical materials and other products made in China. Thanks to technology, however, although neat is the share of imports in sustaining and delivering economic growth.

Exports of goods and services should equally prevail to fulfil a lot of objectives, such as exchange rate stability, economic growth, investment and favourable balance of payment. The balance of payment means the equilibrium that exists between the volume of imports and exports. For example, in econometrics, there are a variety of models developed to establish the long-run cointegration between the variables. They help economists to establish the existence of such equilibrium in economic time series variables. For example, most studies in the literature have investigated the impacts of exchange rates on exports and imports separately such as (Doğanlar, 2010; Ngondo and Khobai, 2018). However, there's a contradiction in the literature since studies like Adesina *et al*, (2021), and Habanabakize, (2020a) concluded that there is a long-run relationship among the variables. While other researchers such as Sweidan (2013) and Bahmani-Oskooee and Wang (2008) found these variables to be statistically insignificant. On the other hand, Bahmani-Oskooee and Wang, (2008); Ngondo and Khobai, (2018) revealed that there is a negative relationship between exchange rates and exports. The study will extend the literature by investigating the cointegration relationship between the import/export against the exchange rate, economic growth and inflation. To further the investigation will employ the vector autoregressive model to detect the nexus between terms of trade, economic growth, exchange rates and inflation.

Looking closer the trend of the export for South Africa among its peers in the BRICS conference is depicted in Figure 1 below. Notice that South Africa is hovering on the lowest rankings below China and India which share the first and second place respectively. Followed by Russia and Brazil in the third and fourth place respectively. All these economies specialise in offering different commodities in the

world at large. Surprisingly South Africa remains with a large number of labour force willing to offer their labour but remain deprived of job opportunities.
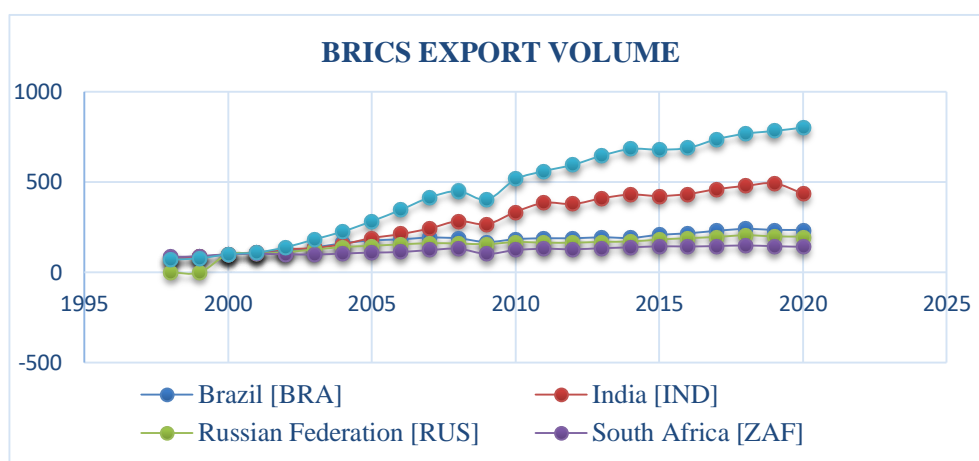

Figure 1. BRICS export volume
Source: Authors computed through data collected from the World Bank

The starting point of Figure 1 is marked in the year 2000, for example, South Africa was celebrating 6 years of democracy and expanded trade with many economies of the world. Turning the focus on Figure 2 below, it looks at the share of exports on economic growth. It is equally surprising that South Africa with the least export among its peers is contrary export dependent. This incident should draw too much attention to the policymakers concerning the volume of exports, economic growth and job creation from all the regions.
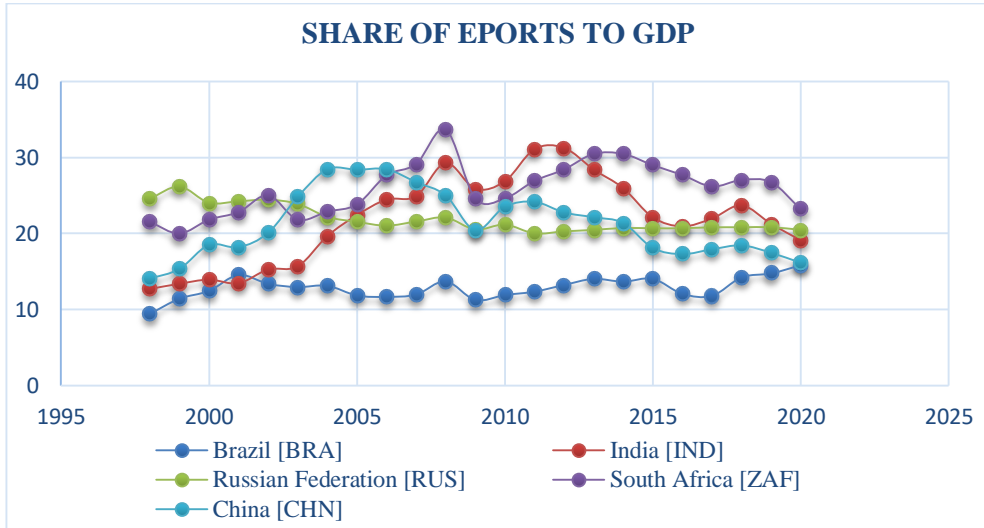
Figure 2. BRICS export volume

Source: Authors computed through data collected from the World Bank

The next Figure 3, shows the share of trade balance for South Africa. The data is skewed on the negative values to indicate the trade deficit the economy has experienced in the years from 2000 to 2019. This is the sign that although Black *et al,* (2016) indicate that in the production process of economy, capital is much more preferred to labour. However, there is still room for more labourers to be absorbed to participate in the economic activities of the economy to supply sufficient goods and services in the global context. The figures that have been highlighted here are silent in terms of the interaction of trade with exchange rates and other monetary policy variables. This is why the study will further employ the econometrics models to capture the deep sense of the selected variables.
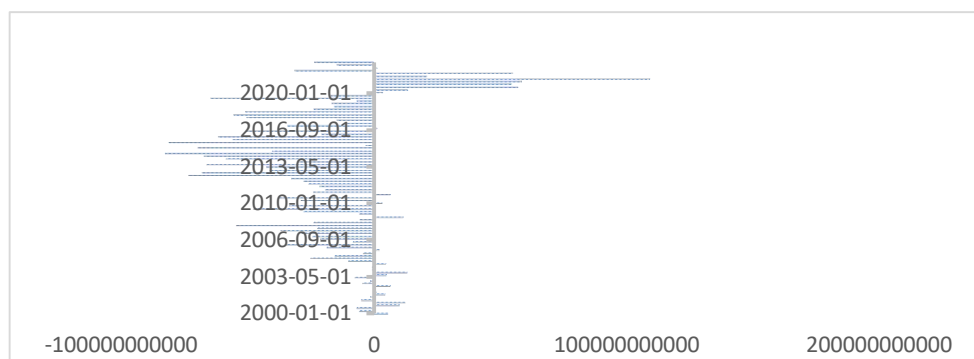

Figure 3. South African Balance of Payment

Source: Authors computed through data collected from FRED

The study is structured as follows: the first section covers the introduction, and the second section covers the theoretical and empirical evidence. Section 3 covers the methodology of the study thereafter sections 4 and 5 cover the result section and conclusion respectively.

2. Literature Review

The study covers Marshall-Lerner (ML), Hecksher-Ohlin theory and Purchasing power parity theory. The theories are linked to the objectives of the study in conjunction with the variables of the study. The Marshall-Lerner (ML) condition occurs when the devaluation of the domestic currency affects the trade balance. ML indicates that devaluation of the local currency results in a trade deficit, hence after a while the trade balance is recovered (Nguyen *et al.,* 2021). The same author volumes that the exchange rate is the Balance of Payment Equilibrium indicator. When there is a change (movements) to the exchange rate this can cause the (BOP) to be in disequilibrium then after a while it corrects itself to get back to Equilibrium through improvement in the terms of trade. The trade balance is exports minus imports. Odili, (2015) argues that when there is a movement in exchange rate such as the depreciation of a home currency, it affects the monetary value of the currency as the domestic currency becomes cheaper and promotes exports. In line with the country-based trade theory, a devaluation of a local currency means a weaker local currency. This is good for exporters to generate surpluses, however, it restricts imports and makes imported commodities more expensive in local currency. That means if the currency depreciates, the exchange rate policy can be adjusted by encouraging exports and restricting imports which is in line with the theory of Mercantilism (Chinweobo 2013). According to Krugman *et al,* (2015), the economic theory of comparative advantage principle stipulates that countries' gains from trade are derived from free trade because world output can rise when each country specialises in what it does relatively best.

Hecksher-Ohlin which is also known as the theory of factor endowment, in the early 1900s the theory brought further improvement to the theories of Ricardo, (Blang 2006). Hechsher-Ohlin's theory proposes that a country will export goods that are intensive in its relatively abundant factor and will import goods that are intensive in its relatively scarce factor (Snowdon and Vane, 2005). This factor proportions theory links a country's pattern of trade to its endowment of factors of production. Owners of a nation's abundant resources profit through trade, but owners of that nation's scarce resources suffer. Paraskevopoulou *et al,* (2016) investigated the United States (US) economy and found that the US is abundant in capital and therefore needs to export more capital-intensive commodities. However, his research using real-world data showed the opposite as the US implicitly classified more capital-intensive commodities. According to factor endowment theory, the US should have imported

labour-intensive goods, but in reality, it exported them. His analysis was the opposite of what was expected from factor-giving theory, so it became known as the Leontief Paradox.

Purchasing Power Parity theory is one of the real exchange rate theories. Cassels, (1918) realises that money is a medium of exchanging goods and services and bought for a price that is expressed in money Purchase Power Parity theory is based on such purchase. South Africa is a developing country that is suitable for surveying the impact of exchange rates on the trade balance because the developing country is labelled as a currency manipulator. The exchange rate exerts a strong influence on a country's trade, (Kemal and Qadir, 2005).

There is considerable disagreement in the literature concerning the direction of the impact of exchange rates on the variables of interest (import and export). For example, Odili, (2015), even though the study confirmed the long-run relationship between the variables. However, negative associations were discovered between the exchange rates and imports. Through the secondary data stretching from 1971 to 2013, cointegration and ECM were employed in the study. Adesina *et al.,* (2021) carried out the study to examine the effect of the exchange rate on exports and imports in Nigeria using the time series annual data for the exchange rate for the year 1981- 2019, secondary data from the Central Bank of Nigeria, Methodology is Error Correction Model for estimating coefficient variables and Vector Autoregressive model to test significance variables. Nigeria is blessed with oil, exchange rate has a positive impact and significant effect on oil. Gachunga, (2019) shared similar sentiments concerning the imports and exchange rates. The study employed the multiple regression model through the data ranging from 1980 to 2013.

On the other hand, some studies make claims against the existence of positive relationships. For example, Nguyen *et al,* (2019), revealed that exchange rate volatility shares a negative relationship with imports and exports. Bound tests for cointegration were validated through the mixed order of integration among the variables. ARDL models were performed through the dataset ranging from 2000Q1 to 2014Q4. Similar trends were maintained by Gachunga, (2019), regarding the export and exchange rates. Habanabakize, (2020a), has validated that during the period of exchange rate appreciation, the exports of goods and services decrease. In the same vein,　Nguyen *et al,* (2021) investigated the impact of the exchange rate on exports and imports between Vietnam and the United States in the context of the trade war. They used Autoregressive Distributed Lag (ARDL) and Nonlinear Autoregressive Distributed Lag (NARDL) models which present evidence that shows that the exchange rate is asymmetric both in the short and long term. The author also discovered that the exchange rate plays a minor role in exports and imports while the trade war plays a vital role in increasing exports and import volume between two countries and the J curve exists between two countries (Vietnam and

United States). In the same vein, NISHAT, (2010) this paper attempts to examine the effect of exchange rate volatility on the real exports of Pakistan. They used Johansen multivariate cointegration tests and error correction model techniques on quarterly data from 1982 to 2000. The results show that the exchange rate hurts exports. In their findings indicated that Pakistan is driven by the volume of world trade and export prices as the coefficients of these factors are positive and statistically significant during the study period from error correction model (ECM) results. They show the exports significant in both short-run and long-run.

The literature further provides relevant studies that have been conducted around the world. For example, Sweidan, (2013) investigated the effect of exchange rate movements on exports and imports in the case of Jordan using time series data from 1976-2009. A bounds testing approach was conducted to determine the data's stationary in methodology. Error correction model was used for the estimation of variables. Consumption and Investment were used as control variables and the results showed that the effect of final expenditure, real consumption and real investment expenditure are positive in the short run. The price elasticity of Jordan's real imports in the long run is relatively inelastic. The real effective exchange rate is statistically insignificant and does not influence real imports. There was an issue of trade balance deficit that became worse because of the rise in the price of oil and food items. There is a long-run relationship among the variables.

Ngondo and Khobai, (2018) assessed the impact of exchange rate on exports in South Africa for the period of 1994 to 2016. The study used interest rate, investment and inflation as control variables, while Autoregressive Distributed Lag (ARDL) approach was employed. The author found a negative relationship between exchange rates and exports in South Africa. Other findings show that the United States plays a vital role for the rest of the world, especially for export-led growth countries like Vietnam. This study also confirmed the main reason why the trade surplus of Vietnam has risen in recent times is because of a trade war between the United States and China. The following section covers the methodology of the study.

3. Methodology

This research analyses time series data to quantify the impact of exchange rate fluctuations on exports and imports in South Africa. The Federal Reserve Economic Data (FREED) span is the secondary data source for a few variables. From 1994Q1 to 2019Q4, quarterly time series data are taken into account in this study. The reality of the objective will be evaluated here. This study attempts to build an econometric model that can provide a better understanding of the relationships between exchange rates, exports and imports in South Africa. Paraskevopoulou *et al,* (2016); and Adebiyi, (2016) argue that when there is a movement in exchange rate such as the

depreciation of a home currency, it affects the monetary value of currency as the domestic currency becomes cheaper and promotes exports. Marshall-Lerner (ML) indicates that devaluation of the local currency results in a trade deficit, hence after a while the trade balance is recovered (Nguyen *et al.,* 2019). The aforementioned theories put exports and imports as the function of exchange rates Artar, (2014); Odili, (2015); Gachunga, (2019); Nguyen *et al,* (2019) to count the few, and other monetary policy variables. Hechsher-Ohlin's theory proposes that a country will export goods that are intensive in its relatively abundant factor and will import goods that are intensive in its relatively scarce factor (Snowdon and Vane, 2005). This study will add GDP growth and inflation as the explanatory variables because to volume of trade is directly affected by growth Habanabakize, (2020b) and it also affects monetary policy.

The following variables will be used in the model and will be available in the data source. The exchange rate is the independent variable or explanatory variable (X-variable). The exports and imports are dependent variables (Y-variables), Consumer Price Index and income (GDP) are the control variables. Where; EXP for trade of commodities export and value of exports using (US Dollar), GDP = Foreign income (US Dollar CPI = for all), items and relative price of export using national currency per Rand. IMP = for the trade of commodities and services and value of imports using (Rand) in millions of rand, GDP for South African income (Rand), CPI for foreign prices and all items using (US Dollar), EXCRT = exchange rate for Balance of Payment, current account and foreign exchange rate, Rand to US Dollar. The VAR model will involve terms of trade variable.

The study uses the ADF cointegration approach that is outlined below. There are a lot of cointegration approaches that exist in the literature such as the Engle and Granger cointegration approach that requires a condition of two variables. The bound test for cointegration requires the combination of stationary and non-stationary variables and the Johannsen cointegration approach that equally uses more than two non-stationary variables. The study employed the ADF since it allowed the research to rely on the stationary of the errors that ensure the absence of heterogeneity and constant variance. It allows the researcher's investigation to go beyond the interpretation of the model to use errors diagnostic test results and establish the error correction model, Gujarati, (2004). If a linear combination of two or more non-stationary series is stationary, then we say the linear conditions of the series are cointegrated Gujarati, (2004). We confirm by testing regression residual stationary. The linear regression model explaining the relationship between these variables implies the residual is I(0). The following model for cointegrating relationship follows the work of Genc and Artar, (2014) long-run function:

$$Y_t = \beta_1 + \beta_2 X_{1t} + \beta_3 X_{2t} + \beta_4 X_{3t} + \mu_t \qquad (1)$$

$Imp = f(EXCRT, GDP, F\_CPI)$

Exp= f (EXCRT, GDP, F_CPI)

Where y_t signifies the dependent variable that could be the import or export, β_1 is the constant then $\beta_2 \ldots \beta_4$ are the coefficients for (x) explanatory variables. The explanatory variables are the same for both import and export. While µt denotes the error term with zero mean and constant variance. The next VAR model will make a similar discussion concerning the terms of trade that have been covered so far.

3.1. Vector Autoregressive (VAR) approach

This subsection provides details on the building blocks of the system of equations approach used in this study. The model below is explained in terms of (Lutkepohl 2005). The starting point is the VAR framework, there are endogenous variables. The endogenous variables are determined within the system. In terms of the mechanism, consider the following structural equation:

$$Y_t = C + A^0 Y_{t-1} + \cdots + A Y_{t-p} + V_t \tag{2}$$

In the above equation, $y_{it} = (y_{1t} \ldots y_{nt})$ n is a vector of endogenous variables. With (t) signifying the model is a time series representation. At the same time, $x_t = (x_t \ldots x_{mt})$. $A^0 (N \times N)$ represents the vector of endogenous. The term v_{it} is K-dimension for error vector and it is assumed to be white noise. The above structural equation cannot be estimated directly using OLS or used to fulfil the objectives of this study. The following representation of the model and selected variables has been adopted from the work of (Hove *et al.,* 2016; Kalumbu And Sheefeni, 2016). The study in this case is interested in the reaction of economic growth, inflation and exchange rates in response to terms of trade (Kalumbu And Sheefeni, 2016). The terms of trade is nothing but the volume of export divided by the volume of imports multiplied by 100. Wong, (2010) validated that increases in terms of trade can lead to either an increase in economic growth if the increase is driven by exports or a decrease in growth if imports dominate the process via investment channel. The following structure of the VAR equations will be understood.

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} \begin{bmatrix} TUT_t \\ EX_t \\ Y_t \\ \pi_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} \end{bmatrix} \begin{bmatrix} TUT_t \\ EX_t \\ Y_t \\ \pi_t \end{bmatrix} + \begin{bmatrix} u_t \\ w_t \\ \varepsilon_t \\ \epsilon_t \end{bmatrix}$$

Where $y_1 \ldots y_4$ represent the dependent variable of each equation. $\alpha_1 \ldots \alpha_4$ Indicates the constant, $\beta_{11} \ldots \beta_{44}$ denotes the coefficients for the explanatory variables. $u_{t1} \ldots \epsilon_t$ Denotes the errors of the equations. The study relies on the impulse response function based on Cholesky decomposition, the contemporaneous shocks determine the effect of the dependent variable explained by its lags and explanatory variables. The VAR estimation involves the lag selection through AIC, HQ and others.

Furthermore, both models involve pre-diagnostics tests (unit root test) and post-diagnostics tests (heteroscedasticity, serial correlation, JB test and, variance decomposition of VAR), as follows.

3.2. ADF Test

The stationarity process plays a crucial role, especially in the cointegration approach and the ADF test is explained in details here. The stationarity of the mean and variance means they both should be constant over time. The covariance value depends on the distance between the period and not on the actual time in which it is computed. Consider the following equations that depict the discussed three elements according to (Gujarati 2003):

Mean $E(Y_t) = \mu$

Variance $E(Y_t - \mu)^2 = \sigma^2$

Covariance $\gamma_K = E[(Y_t - \mu)(Y_t - \mu)]$

The mean and variance are stationary and in the covariance, the small k denotes the distance periods. Therefore consider the following equation

$$y_t = \rho y_{t-1} + u_t \qquad 1 \le \rho \le 1 \qquad (3)$$

In the above equation, the variable ρ is nothing but (rho), if $\rho = 1$ it means unit root problem and the model variable under consideration is not stationary. The non-stationarity of the model can be caused by the presence of the trend in the variable which makes it predictable. On the other hand, it can be caused by stochastic terms which makes it to be unpredictable. Hence on the other hand if $\rho = 0$, it means the model is stationary, it is ready to be used in a regression model and it can produce reliable results.

Therefore for time series data, this study will focus and rely on the augmented dickey-fuller (ADF) and Philips-Perron (PP) tests that are common in the literature. Consider the following equation 4 based on the ADF test:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i-1}^{m} \alpha_1 \Delta Y_{t-i} + u_t \qquad (4)$$

The above model has been augmented since it includes the lagged variable of the dependent variable. As stated in the above section, t denotes the time trend if the model is non-stationary. Based on ADF, the coefficient $\delta = 0$ in case of the presence of the unit root problem. The error term is assumed to be white noise independently distributed and identically distributed. The following section covers the result section.

4. Results and Discussion

Table 1 below presents the summary which describes the whole data set in terms of the measure of central tendency (Mean, and Median), and measures of dispersions (Standard deviation). These parameters measure the common behaviour of the dataset, and how the data is spread from its mean respectively. Sharma (2019) emphasises the exploration of the data set through the use of descriptive statistics before engaging in estimation. The observations are 104 is the dataset that is enough to apply the econometrics data to make a valid analysis.

Table 1. Descriptive Statistics Table

	TOT	IMP	GDP	EXP01	EXCH	CPI
Mean	0.539423	1.70E+11	889871.8	1.71E+11	8.356838	68.86526
Median	0.550000	1.61E+11	926821.5	1.55E+11	7.561750	60.34399
Maximum	15.40000	3.88E+11	1152273.	3.91E+11	15.54500	123.4612
Minimum	-9.500000	2.16E+10	586899.4	2.51E+10	3.479500	29.55666
Std. Dev.	3.621870	1.18E+11	187048.2	1.16E+11	3.278916	27.17099
Skewness	0.847878	0.355723	-0.114144	0.415992	0.573510	0.450457
Kurtosis	6.319629	1.655301	1.504387	1.792713	2.335950	2.024767
Jarque-Bera	60.21394	10.02893	9.918884	9.315540	7.612010	7.638478
Probability	0.000000	0.006641	0.007017	0.009488	0.022237	0.021944
Sum	56.10000	1.77E+13	92546670	1.77E+13	869.1111	7161.987
Sum Sq. Dev.	1351.148	1.44E+24	3.60E+12	1.39E+24	1107.383	76041.07
Observations	104	104	104	104	104	104

The stationary tests indicate that all variables are stationary after taking the first difference except for the terms of trade. However, the ADF cointegration will only involve import/export as the dependent variables, then CPI, exchange rates and GDP growth. The stationary of the errors implies that the model itself is cointegrated. The VAR model will then involve the terms of trade as the dependent variable.

The variables involved in the cointegration model such as import, export, inflation, GDP growth and exchange rates are all stationary after taking the first difference. None of the variables is stationary after taking the second difference. While other additional variables (EM) denote the errors (E) of the model with import (M) as the dependent variables. EX denotes the errors of the model where exports (E) are the dependent variables. Both variables should be stationary at level (I0) when the ADF test is applied to indicate that there is long-run cointegration according to (Gujarati

2003). The results indicated above are in line with (Genc & Artar, 2014; Odili, 2015; Oluyemi and Essi, 2017).

Table 2. Stationarity tests

Augmented Dickey-Fuller test stat (ADF)			Philip Perron (PP)		
Variable name	I0	I1	Order	I0	I1	order
CPI	-0.576	-6.25***	I1	-0.253	-6.236***	I1
EXCH	-2.0422	-9.18***	I1	-2.2364	-9.153***	I1
TOT	-15.3***	-----------	I0	-16.263***	----------	I0
M	-2.427	-8.98***	I1	-2.453	-9.069***	I1
X	-2.2452	-8.64***	I1	-2.079	-9.484***	I1
GDP	-0.7190	-6.06***	I1	-0.7783	-6.1326***	I1
ECM	-11.63***		I0			
ECX	13.08***		I0			

Note: (***) significant at 1%.

Therefore the study will continue to estimate the error correction models for import and export indicated in tables 3 and 4. The following Table 3 indicates the error correction model following the long-run existence between the variables. Therefore the ECT is negative and statistically significant, meaning the dependent variables correct 41% of errors back to equilibrium in every quarter following the short-run deviation. The constant term is negative and statistically significant at 10% to signify the holding constant of all other variables, export is negative in the short run indicating the BoP deficit. However, all explanatory variables such as GDP growth, inflation and exchange rates have positive effects on the export of goods and services. The GDP growth holds the highest influence to indicate, how significant the economic growth is to exports. The results follow the footsteps of (Habanabakize 2020a). Followed by the inflation rates and thereafter the exchange rates.

Table 3. Export (Dependent Variable)

Variable	Coefficient	Sdt. Error	T-stat	Prob
D(LEXCH)	0.183656	0.053492	3.433313	0.0009
D(LCPI)	1.057184	0.434341	2.433996	0.0167
D(LGDP)	4.0111031	0.675772	5.935477	0.0000
ECT(-1)	-0.413502	0.075325	-5.489560	0.0000
C	-0.016885	0.008667	-1.948214	0.0542
R-squared	0.469314			
Adjusted R-squared	0.447654			
F-stat	21.66669			0.0000
Durbin –Watson stat	2.017032			

Heteroscedasticity test: Breusch-Pagan-Godfrey	0.625421	0.6455
Breusch-Godfrey Serial Correlation LM test	0.258383	0.7728
Jarque-Bera test	1.33766	0.5127

Source: Authors' computation

The goodness of fit for the model is 46% and the F-stat holds a high value that is statistically significant. This means the model is truly explained by the selected variables in the short run. The D-B is 2.02 and is equally backed by the LM test which has a p-value that is above 0.05 to indicate the absence of serial correlation among the variables. The errors of the model are normally distributed denoted by the p-value of the heteroscedasticity test that is above 0.05. The error correction term for the imports indicated in Table 3 below asserts that a 50% short-term deviation is corrected back to equilibrium in every quarter in the long run. On the other hand GDP growth has a positive and significant effect on the volume of imports, (Habanabakize 2020a). This is in line with the IS-LM-BP theory that asserts that high income influences economic participants to afford imported goods via exchange rates, (Snowdon and Van 2003). Equally important, the inflation and exchange rates have positive impacts on imports (Odili 2015). However, the effect of inflation is statistically insignificant in the short run.

Table 4. Import (Dependent Variable)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH)	0.700710	0.071698	9.773135	0.0000
D(CPI)	0.617034	0.372382	1.656994	0.1007
D(GDP)	1.258972	0.643718	1.955782	0.0533
ECT(-1)	-0.505583	0.082685	-6.114594	0.0000
C	-0.007596	0.007297	-1.041017	0.3004
R-squared	0.662688			
Adjusted R-squared	0.648920			
F-statistic	48.13306			0.0000
Durbin-Watson stat	2.033143			
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.222232			0.4480
Breusch-Godfrey Serial Correlation LM Test	0.933255			0.4480
Jarque-Bera test	14.7886			0.00065

Source: Authors' computation

The exchange rates hold a significant value that is not surprising because it is always involved during the trade of goods and services. The diagnostics tests validate that the model does not suffer from serial correlation and heteroscedasticity of the errors. The model has a high goodness of fit that reaches 66% which indicates the

relatedness of the explanatory variables to explain the dependent variable. The following section focuses on VAR model interpretation.

4.1. VAR model

Table 4 below indicates the suggested three lag length criteria that indicate three lags for each consecutive equation. On the other hand, SC and HQ have suggested only one lag for each equation. The study will utilise three lags for each equation as suggested by AIC and others.

Table 4. VAR Lag Order Selection Criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	41158056	28.88444	28.99197	28.92789
1	75.54680	24909249	28.38187	28.91953*	28.59912*
2	25.16872	26083735	28.42605	29.39384	28.81711
3	36.59113*	23489469*	28.31666*	29.71457	28.88152
4	22.05556	25010629	28.37074	30.19878	29.10940
5	7.752700	31991648	28.60281	30.86098	29.51528
6	16.75116	36019420	28.70035	31.38865	29.78663
7	20.24316	38239343	28.73048	31.84890	29.99056
8	15.42368	43474393	28.81855	32.36710	30.25243

Source: Authors computation from reviews

Figure 4 below shows the validity of the VAR model with three lags. The validity is implied by the all roots of AR characteristics that lie within the cycle.
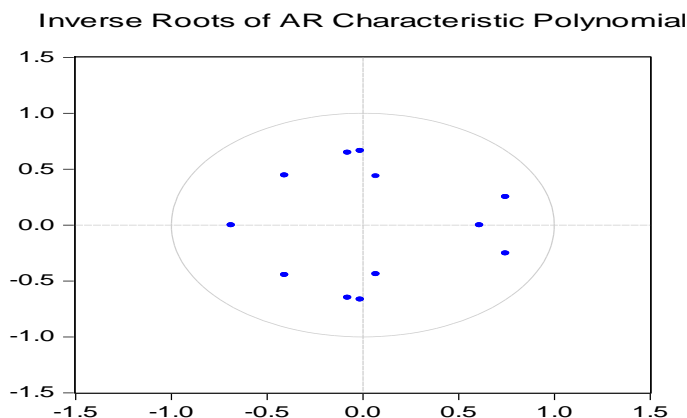

Inverse Roots of AR Characteristic Polynomial

Figure 4. AR Polynomial

The impulse response functions are presented in Figure 5 below. The first row indicates the responses of terms of trade to the explanatory variables. TOT represents terms of trade, DY denotes GDP growth DCP represents CPI and (D) denotes the

difference operator. The response of TOT is the same for all variables however the response is larger and faster to its innovations. The response graph first decreases following one standard deviation shock of TOT. However, it becomes silent in the first quarter and starts to decrease in the second quarter, while increasing in the third quarter for a short period before it reverts to zero. This implies that SA as a net importer experiences the BOP deficit over time. The value of exchange rates, the working of the monetary policy and slow growth hamper terms of trade.

The second row indicates the response of exchange rates to TOT, CPI and economic growth. One standard deviation causes the exchange rate depreciation the effect begins in the first and diminishes in the third quarter. This implies that the terms of trade are dominated by imports that lead to a lower level of standard of living through trade deficit. Equally important one standard deviation shock of the exchange rate weakens the Rand. The effect of GDP and CPI on the exchange rate remains silent. This could be explained by slow growth and the internal focus of monetary policy.

In the third column, one standard deviation shock of the exchange rate increases the rate of inflation rates. Implying the significance of the exchange rate pass-through effect that could be caused by relying more on imported goods in SA. The effect lasts for 6 quarters before it reverts to equilibrium. While the GDP growth holds a silent effect on inflation rates following the findings of Ngubane, Mndebele, and Ilesamni (2023) monetary policy responses to GDP are not significant in SA.
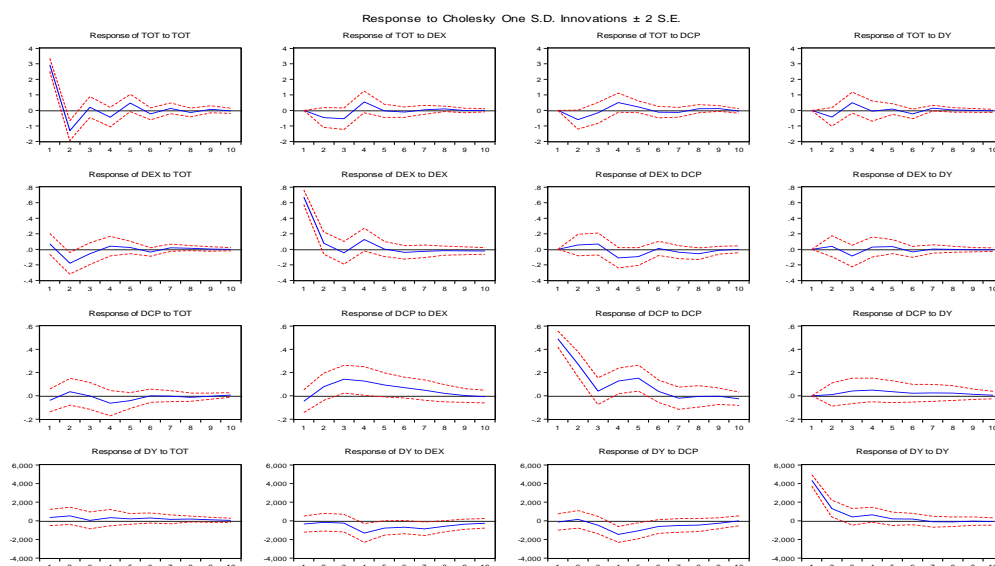

Figure 5. Impulse Response Functions

The last column indicates tiny negative effects of inflation and exchange rates on economic growth. The results move with the motion that high inflation harms growth in the long run together with unstable weak exchange rates. While economic growth

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standard deviation reduces itself over time. Table five below shows the diagnostics test of the serial correlation and heteroscedasticity test. The LM-stat test indicates the absence of the serial correlation between the variables from lags one to three, the P-values start to be less than 5% at lag number four. Moreover, the heteroscedasticity test indicates that the errors are normally distributed since the p-value is above 0.05 significant level.

Table 5. Diagnostics Tests

Diagnostics tests	Lags	LM-Stat	Prob
Serial correlation	1	20.94947	0.1805
	2	19.29169	0.2538
	3	**24.06878**	**0.0880**
	4	27.11686	0.0402
Heteroskedasticity Tests		Chi-sq 276.2943	0.0537

Source: Authors' computation

Figure 6 below depicts the results of the variance decomposition. The results correspond to the impulse response function, for example, the first column indicates that the TOT is only explained by its lags for the whole period. The exchange rates are explained by their lags and exchange rates since import and export involve currency. The third column equally indicates the pass-through effects of exchange rates on inflation.
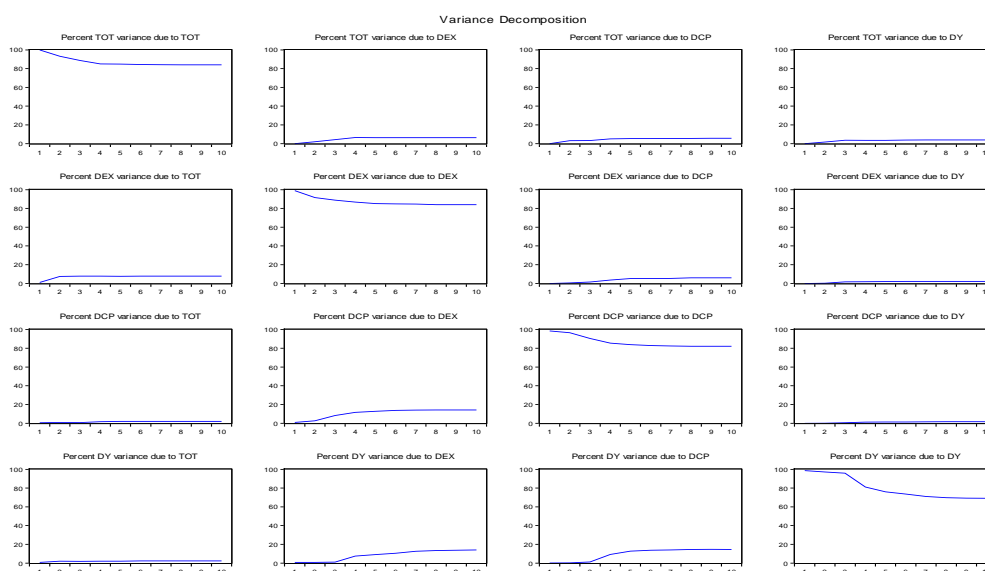

Figure 6. Variance Decomposition

The last column indicates that economic growth is explained by its lags, exchange rates and inflation rates as indicated by the impulse responses in the first figure.

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5. Conclusion and Policy Recommendations

The study has emerged to investigate the equilibrium existence between the import/export and exchange rates, economic growth and inflation. The balance of payment is concentrated on import and export volume that takes place through changes in the exchange rates. The ADF cointegration has been employed to detect the existence of the equilibrium in the aforementioned variables. Following the disagreement that exists in the literature and the lack of attention in the same field in the South African context. The cointegration approach holds in SA, meaning there is a long-run equilibrium between the export, exchange rates, and economic growth and inflation rates. The same could be said between import and the latter variables. The study further included the terms of trade in the process, to explore the nexus between the terms of trade, economic growth, exchange rates and inflation via the VAR model. The study findings confirmed that the terms of trade have a significant impact on exchange rates. The latter pass-through affects inflation rates while growth is not highly affected by terms of trade but negatively affected by inflation and exchange rates. The study argues that policymakers to accelerate the volume of imports via the labour-intensive sectors to curb the high unemployment, reduce the trade deficit and accelerate growth. Furthermore, monetary policy authorities should fight against inflation above the target band while exchange rates should equally be stabilised to stimulate growth.

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