International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Modelling the Relationship between Exchange Rate and Balance of Trade Components in Rwanda (2005-2012)

Ndayambaje Godefroid[1], Joseph Mung'atu[2]

[1, 2]Jomo Kenyatta University of Agriculture and Technology

Abstract: ***This study sought to model the relationship between exchange rate and BOT in Rwanda. Specific objectives were to test for the stationarity of exchange rate and BOT components, to determine the relationship between exchange rate and BOT components and to investigate the effects of BOT components on exchange rate in Rwanda. The study utilized monthly time series data from 2005 to 2012 sourced from BNR and NISR. The study carried out ADF and PP unit root tests, Johansen cointegration test, Quantile regression and impulse response function tests. The results of ADF and PP tests revealed partial stationarity at level and full at first difference. Johansen cointegration tests revealed a long run relation between exchange rate and BOT components. Quantile regression results revealed positive significant effect of BOT components on exchange rate. The impulse response results also confirmed the same. The study recommends adoption of import reduction strategies and export expansion strategies.***

Keywords: Exchange rate, BOT, Exports, Imports (c.i.f), Imports (f.o.b), Quantile regression

1. Introduction

Background of the study

Exchange rates play an important role in linking a country to the global supply chains. Exports generally include high import content and the impact of these imports and exports on exchange rate depreciation or appreciation is therefore complex. Theory posits that exports makes the countrys currency to appreciate while imports causes depreciation of currency. Although exchange rate hedging mechanisms are available, they are probably somewhat prohibitive for some particularly small and medium-sized enterprises, which may have less long-term visibility of their foreign exchange needs.

The economic crisis has had a differentiated impact on the world economies and on their trade, thereby changing trade patterns significantly in some cases. In the context of low employment related to recession, some policymakers want to stimulate their exports, thereby hoping to improve their trade and current account balances.

Rwanda had an administered economy, which imposed severe restrictions on trade and foreign exchange transactions and a fixed exchange rate regime (1961-1990). By the early 1990s the average tariff rate was 34.8%, with 5 different tariffs ranging from 0-60%. Every import and every importer was subject to a quota, and all import operations were subject to a license authorizing external currency disbursement. Exporters had to repatriate currency generated by the sale of exports as a legal requirement. Export licenses were authorized only by the *Banque Nationale du Rwanda* (BNR). More importantly, all export earnings were transferred to and managed by the BNR.

The period from 1991 until 1994 corresponds to the beginning of the removal of restrictions on trade and foreign exchange transactions, and the gradual revival of a market economy, Rwanda embraced a market economy characterized by continuation of trade reforms and a liberalization of the monetary and financial regimes. Tariffs were reduced considerably with the average rate decreasing to 18%, and there remained four tariff bands with a maximum of up to 30% by 2003. This is a significant reform when compared with an average tariff rate of 34.8%, with 5 different tariffs ranging from 0-60% prior to 1994

Liberalization of the monetary and financial sector led to the adoption of new currency exchange regulations, the creation of new private commercial banks, and the privatization of state-owned banks. Imports, exports and services were liberalized, and some of the previous restrictions on capital flows were either reduced or eliminated. Rwanda's exports remained dominated by traditional products such as coffee, tea and minerals like tin, coltan (Colombo tantalite), wolfram and cassiterite. Rwanda's main exports partners are China, Germany and United States. Rwanda imports mainly food products, Raw materials, machinery and equipment, construction materials, petroleum products and fertilizers. Main imports partners are Kenya, Germany, Uganda and Belgium.

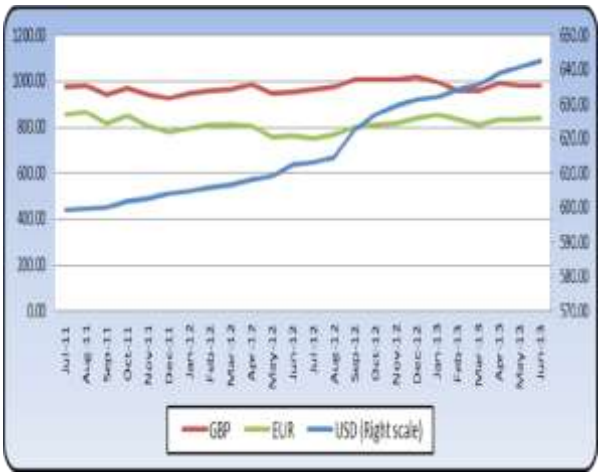

Figure 1: Evolution of Nominal Exchange Rate, Leading Currencies against USD
Source: BNR, Annual Report 2013

Balance of trade

Trade, in general connotation, means the purchase and sales of commodities. In International Trade, purchase and sale are replaced by imports and exports. Balance of Trade is simply the difference between the value of exports and value of imports. Thus, the Balance of Trade denotes the differences of imports and exports of a merchandise of a country during the course of year.

Types of Balance of trade

Based on sale and purchase of goods and services, balance of trade can be divided into following three groups:

Import Trade: Import trade refers to purchase of goods by one country from another country or inflow of goods and services from foreign country to home country. For example, the purchase of oil, clothes, computers, vehicles, etc. by Rwandans from abroad.

Rwandan imports include two types of imports: **Imports f.o.b** stands for **Free on Board**, it refers to the physical location that title to the goods changes hands from the shipper to the recipient at that point, the recipient assumes the risk of loss and takes responsibility for any shipping charges. The second one is **Imports c.i.f**, stands for **Cost, Insurance and Freight**, the cost of goods plus insurance and freight charges, normally to the port of embarkation unless a different f.o.b point is specified.

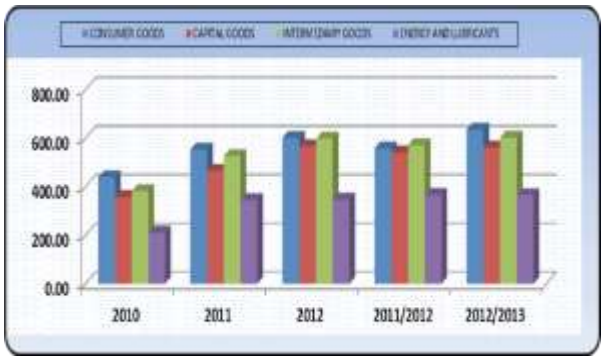

Figure 2: Structure of Rwanda Imports Developments (value in USD million)
Source: BNR, Annual Report 2011

Export Trade: Export trade refers to the sale of goods by one country to another country or outflow of goods from home country to foreign country. For example, the sale of Tea, Coffee, pyrethrum, etc. by Rwandan companies abroad.

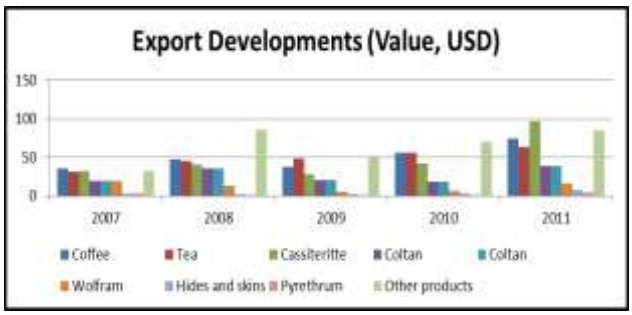

Figure 3: Major exports Developments(Value in USD million and volume in tons)
Source: BNR, Annual Report 2011

Objectives of the research

1) To test for stationarity of exchange rate and balance of trade components in Rwanda.
2) To investigate the relationship between exchange rate and each of the BOT components in Rwanda.
3) To determine the influence of BOT components on exchange rate in Rwanda.

2. Research Methodology

Descriptive research design was used in this study. time seies data was used for a period of 12 years. ADF and Philips Perron tests were used to test stationarity of variables, Johansen cointegration method to test for cointegration (johansen and Joselius, 1990) and quantile regression to test for the influence of BOT components on exchange rate. In this study, Augmented Dickey Fuller (ADF) test and Philips -Perron unit root test were used to detect the stationary of the variables. The study adopted Philips - Perron test in addition to Augmented Dickey Fuller both at I(0) and (1) for more confirmatory test because the ADF assume no autocorrelation of the error term biases, hence its control ensures that the error term is a white noise according Wooldridge, (2003). Unlike the ADF, the PP method corrects for autocorrelation using non-parametric statistical methods without adding lagged difference terms Gujarati, (2003).

QR models could not only be used to detect heterogeneous effects of covariates at different quantiles of the outcome, but also offer more robust and complete estimates compared to the mean regression, when the normality assumption is violated or outliers and long tails exist, (Huang et al, 2017).

Model Specification

In this study the three explanatory variables that is exports, imports (c.i.f) and imports (f.o.b) affecting exchange rate were presented in the equation (1) below to estimate the relationship of variables. The model connects BOT components that is exports and imports and exchange rate.

$$RER = \beta o + \beta 1E + \beta 2Ic + \beta 3If + \varepsilon t \ldots\ldots(1)$$

Where

$RER \Rightarrow$ Real exchange rate

$E \Rightarrow$ Exports

$Ic \Rightarrow$ Imports (cost, insurance and freight)

$If \Rightarrow$ Imports (free on board)

$\beta o \Rightarrow$ Constant

$\beta 1, \beta 2, \beta 3 \Rightarrow$ Coefficients of independent variables

$\varepsilon t \Rightarrow$ Error term

3. Findings and Discussion

Stationarity test results

The variables are all stationary at first difference, (Amos, 2017) from the below table.

Table 1: Unit root Test results summary

	Augmented Dickey Fuller Test	Philips Peron Test
	Probability at level probability at 1st dif	Probability at level probability at 1st dif
Exchange rate	0.7506 0.0000	0.7708 0.0000
exports	0.0035 0.0000	0.0039 0.0000
Imports cif	0.0072 0.0000	0.0108 0.0000
Imports fob	0.0001 0.0000	0.0001 0.0000

Source: researcher, 2018

Table 2: Cointegration test results

Date: 01/27/18 Time: 15:16
Sample (adjusted): 2005M04 2012M12
Included observations: 93 after adjustments
Trend assumption: Linear deterministic trend
Series: EXCHANGE RATE, EXPORTS, $IMPORTS_{cif}$, $IMPORTS_{fob}$
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Critical Value	0.05 Prob.**
None	47.85613	0.0042
At most 1	29.79707	0.3243
At most 2	15.49471	0.5187
At most 3	3.841466	0.9003

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Critical Value	0.05 Prob.**
None	27.58434	0.0401
At most 1	21.13162	0.3622
At most 2	14.26460	0.4320
At most 3	3.841466	0.9003

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: researcher, 2018

The probability of no cointegrating equations for trace and maximum Eigen value are 0.0042 and 0.0401 respectively which are less than 0.5. The null hypothesis of none of the equations are cointegrated is rejected for both methods. There is long run relationship between the variables..

Quantile Regression model

Table 3: Quantile regression results

Dependent Variable: EXCHANGE_RATE
Method: Quantile Regression (Median)
Date: 02/03/18 Time: 08:35
Sample: 2005M01 2012M12
Included observations: 96
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.21218
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	532.3816	5.390327	98.76611	0.0000
EXPORTS	8.36E-07	3.16E-07	2.648029	0.0095
IMPORTS_C_I_F	1.52E-07	1.13E-07	1.350369	0.0102
IMPORTS_F_O_B	1.38E-07	1.82E-07	0.758296	0.0252
Prob(Quasi-LR stat)	0.000000			

Source: researcher, 2018

Exports have a positive effect on exchange rate. A unit increase in exports increases the value of exchange rate by 8.36E-6 and vice versa. This positive influence of exports on exchange rate goes against the theory which states that exports makes the domestic currency strong and hence appreciation of currency. However this scenario could be explained by the fact that most of the exports from EAC are in small quantity and still agriculture based and hence fetches less in the external market. The net effect could therefore be positive causing depreciation of currency.

A unit increase in imports (cif) and imports (fob) increases the value of exchange rate by 1.52E-06 and 1.38E-05 respectively. This positive effect is in line with the theoretical review since imports bring high demand of foreign currency and hence the local currency loses value leading to depreciation. The results however show that imports (fob) have a greater effect than imports (cif) on exchange rate.

The study adopted the following linear model to show the effects of BOT components on exchange rate.

$$RER = \beta o + \beta 1E + \beta 2Ic + \beta 3If + \varepsilon t \ldots\ldots\ldots (1)$$

Given the above coefficients, the model becomes

$$RER = 532.381 + 8.36E-07e + 1.52E-07Ifc + 1.38E-07If$$

Impulse Response Function

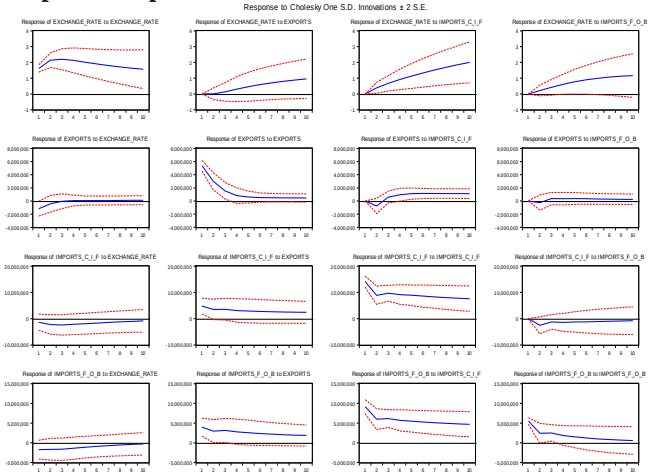

Figure 4: Impulse Response Functions
Source: Researcher 2018

From the figure above the response of exchange rate to a change in BOT components is positive shown by the increasing blue lines above the zero baseline.

4. Conclusion and Recommendation

4.1 Conclusion

The exchange rate and BOT components are stationary. There is long run relationship between exchange rate and BOT components. There is a positive significant effect of BOT components on exchange rate.

4.2 Recommendations

The government should adopt export promotion strategies through setting up export processing zones, setting more industries in the manufacturing sector in order to produce more industrial products and improve on value addition to the manufactured goods in order to fetch high prices.

The government should focus in providing quality education to the youths to acquire skills to exploit the idle resources to increase production. Impose heavy tariffs on importation of goods which are otherwise manufactured locally. These goods may be imported at cheaper prices and low quality and hence compete unfavorably with the local production. The government should only allow importation of those commodities which the country is not able to produce or the country's production is not able to meet the domestic demand.

References

[1] Brooks, C. (2008). *Introductory Economics for Finance*. Cambridge: Cambridge University Press
[2] Huang et al (2017). Quantile Regression models and their Applications. *Journal of Biometrics and Biostatistics*, pp 354.
[3] Engel and Granger (1987). *Cointegration and Error Correction: Representation ,Estimation and Testing*. Econometrica.
[4] Gujarati, D.N. (2003) Basic Econometrics. (4th Edition edn) McGraw Hill.
[5] Hjalmarsson, E., and P. Osterholm, 2007. Testing for Cointegration Using the Johansen Methodology when Variables are Near-Integrated, IMF Working Paper 07/141, International Monetary Fund.
[6] Johansen and Joselius (1990). Maximum likelihood estimation and inference on cointegration with application to the demand for money. Oxford Bulletin of Economics and Statistics
[7] Shukla and Amos (2017). Effect of Government Expenditure on Economic Growth in Rwanda(2005-2015). *International Journal of Economic, Commerce and Management*.
[8] Simbi Eric. (2016). Empirical Analysis of determinants of Exchange rate in Rwanda(2000-2015) . *Journal of Economics and Sustainable development*, 7(18), 169-184.
[9] World Bank, (2011). *Rwanda Economic Update.* Kigali: Spring Edition.
[10] Wooldridge, Jeffrey M. (2003): Introductory Econometrics: A Modern Approach, 2nd edition, South Western College Publishing.