Applying Vector Error Correction to Model Export in Rwanda

[1]GASHEJA Christophe, [2]Dr. Joseph MUNG'ATU, [3]INGABIRE Joselyne, [4]NDAKAZA Jean Napoleon, [5]HAGENIMANA Felix

Faculty of applied sciences, Department of statistics and actual sciences, Jomo Kenyatta University of Agriculture and Technology, Kigali, Rwanda

Abstract: The model uses observed data from 1976 to 2013 on FDI, GDP, Industrial added value, Savings. Unit root test was conducted in order to know if the data are stationary. The co-integration approach was employed to investigate the long-run relationship between export and variables mentioned above. But we first assessed the order of integration of variables, and then assessed co integration among the variables (Long-run relationship) and short-run adjustments to retain the long-run equilibrium. Finally we have analyzed the dynamic relationship between export and hypothesized determinant. After differencing data the unit root test show that the series became stationary, it means the series are found to be integrated of order one i.e I(1) . To the other side Foreign Direct Investment (FDI) become stationary at level. The co-integration is possible because we found that among five series, four are integrated at the same highest order which is order one in our case. The results gave an indication for the existence of a long-run relationship between exports (EXPO), Foreign Direct Investment (FDI), Gross Domestic Product (GDP), and Industrial value added (IVA) and Savings (SAV). The size of the speed of adjustment (-0.80) shows that the economy will converge towards the long run equilibrium in approximately one year following a shock. The empirical results shows that Foreign Direct Investment, Gross Domestic Product, Industrial Value Added are statistically   significant in short run. To the other side Savings is not statistically significant; this is because short term deposits are used for early future consumption but not for investment perspectives. The value of R-squared (R2) shows that about 80 % of the variation in exports is explained by the combined effect of all variables considered. It also indicates that the explanatory variables contribute significantly in explaining the exports activity. This is the indicator of a good model which can be used for policy implication.

Keywords: Export, Vector Error Correction Model, Stationarity, Long-run and short-run relationship.

1. INTRODUCTION

According to the orthodox classical economist as well as to the modern liberal view trade is equivalent to an engine of economic growth. Exports promotion strategy is often in accordance with the principle of comparative advantage, when a country specializes in a product, which it can produce competitively. The goods become available to the community of the world at cheaper prices. The markets are extended. The internal and external economies are attained. Income and employment levels expand. Consequently process of economic development facilitated. In nutshell, putting more emphasis on the export promotion would permit the optimal allocation of world resources and, therefore, returns from trade sector depend upon accelerating growth of export (Muhammad and Eatzaz, 2006)

It is well known fact that trade in Rwanda is characterized by permanent imbalance of the trade balance (given that the country imports more than it exports).The fiscal year 2013/2014, the trade balance stood at USD 1,212.93 million, the total exports value amounted to USD 707.32 million and the total imports FOB to USD 1,920.25 million. Compared to 2012/2013, exports value remains almost unchanged, while imports value slightly increased by 0.9%. Following these trends, trade deficit deteriorated by 1.5% Thus, imports cover declined to 36.8% in 2013/14 from 37.2% registered in 2012/13(BNR Annual Report ,2014),and this affects negatively economy of country. Export instability affects the general

performance of the economy. Identifying the determinants of export will help provide information to the policy makers to enable them come up with the appropriate policies regarding to the growth of the sector and the economy as whole.

2. LITERATURE REVIEW

The Rwandan economy is based on the largely rain fed agricultural production of small, semi subsistence, and increasingly fragmented farms. It has few natural resources to exploit and a small, uncompetitive industrial sector. While the production of coffee and tea is well-suited to the small farms, steep slopes, and cool climates of Rwanda and has ensured access to foreign exchange over the years, farm size continues to decrease. Today and in the recent past Rwanda's export per capita are among the lowest in the world. The per capita of merchandise exports is rated at US$19 IN 1987(JACOB Meerman, 1991). The government has attempted to promote the export sector through establishing agencies to help exporters by providing them with incentives and advices. However, Rwanda is experiencing poor and deteriorating terms of trade manifested by the deficit in the balance of payment (BNR Annual Report, 2013). The following determinants are going to be considered in this study due to the potential contribution to export as it is shown below by the different researchers:

2.1 Independent variables:

2.1.1 Foreign direct investment determinant:

Foreign Direct Investment (FDI) refers to international investment in which the investor obtains a lasting interest in an enterprise in another country. Most concretely, it may take the form of buying or constructing a factory in a foreign country or adding improvements to such a facility, in the form of property, plants, or equipment. The experience from a number of countries suggests that FDI strongly contributes to the transformation of the composition of exports, thus affect export performance positively (UNCTAD, 2004). For instance, it has been well documented that FDI inflows into Singapore or, more recently China, helped to increase significantly the technological content of exports by supporting strongly the development of export supply capacity, including knowledge-base industries (Tordaro, 2009).

Hoekman and Djankov(1998) analyzed the magnitude of change in the export structure in central and Eastern European countries. They investigated the relative importance of subcontracting trade, imports of input, and FDI as determinants of the countries 'export performance in European Union markets. A statistical analysis of the extent to which these variables are associated with the countries' export composition during 1990-95 was undertaken. The findings of this study suggested of all the countries look at, only Poland had a significant positive association between FDI and exports structure.

2.1.2 Gross domestic product determinant:

Gross Domestic Product (GDP) is assumed to have a positive impact on exports. Kumar(1998) conducted a study on the determinants of export growth in developing countries and confirmed that GDP has a significant positive impact on volume of exports. He further said higher level production is the main cause of export expansion since surplus out can be exhausted in the international markets. Ngeno (1996) carried out a study on determinants of exports and one of his findings was that export growth is positively related to output level since higher production leads to increase export volumes.

Rodrik(1999) carried out a regression analysis on pooled cross section and time series data for 1964-1994. Using export growth rate as a function of a wide range of determinants including trade policies, income levels an geographic variables in a sample of 37 Sub Sahara Africa Countries, was established that GDP has a statistically significant effect on export growth.

2.1.3 Industry Value added:

The agricultural output is subjected to uncertainty, particularly because of operation of nature's vagaries. Accordingly, now a day, just on the basis of agricultural. Output no country has greater incomes and outputs. On the other hand, it is the Industrialization that results in maximum utilization of natural and human resources of the country and industrial output is more or less stable. Thus industrialization will provide greater stimulus to output and national income of the country. Industrialization also promotes agriculture sector and agriculture uplifts the industrial sector. The industrial development will have the effect of developing the allied and related sectors.

The situation of persistent deficit in balance of payments is attributed to concentration in agriculture exports, falling prices of exports, the imports restrictions by rich countries and the increasing import bill due to increased demand for oil and manufactured products, etc. Through industrialization a country can enhance industrial production; replace the agriculture exports by the industrial exports, which command reasonable and stable prices in the world markets. Moreover, industrialization reduces dependence on imports by initiating the process of import substitution. Keeping in view all such arguments, we conclude that industrialization has favorable effect on exports

2.1.4 Savings determinant:

Gross national savings, defined as gross domestic savings plus net income and net current transfers from abroad, are measured as percentage of GDP. Official development assistance and net official aid record the actual international transfer by the donor of financial resources or of goods or services valued at the cost to the donor, less any repayments of loan during the same period. Generally, in developing countries the proportion of savings used for nonproductive factors, for example purchasing of jewelers, property, etc, is large. Therefore, higher savings result is large volume of goods made available for exports. So we expect positive impact of this determinant on export.

3. RESEARCH METODOGY

Vector Error Correction model:

According to Asteriou (2007), it is quite common in economics to have models where some variables are not only explanatory variables for a given dependent variable, but they are also explained by the variables that they are used to determine. In those cases, we have models of simultaneous equations, in which it is to clearly identify which are the endogenous and which are the exogenous or predetermined variables. The decision regarding such differentiation among variables was heavily criticized by Sims (1980). According to Sims (1980), if there is simultaneity among a number of variables, then all these variables should be treated in the same way. In other words, these should be no distinction between endogenous and exogenous variables. Therefore, once this distinction is abandoned, all variables are treated as endogenous. This means that in its general reduced form, each equation has the same set of regressors which leads to the development of the VAR models. If the variables are co integrated: the error correction term has to be included in the VAR model. The model becomes a vector error correction model (VECM) which can be seen as a restricted VAR (Gujarati, 2011).

When the variables of a VAR are co integrated, we use a vector error-correction (VEC) model.

Consider how co integrated variables can be used in a VAR using a vector error-correction *(*VEC*)* model. First we examine the two-variable case, which extends the simple Single-equation error-correction model to two equations in a straightforward way. We then generalize the model to more than two variables and equations, which allows for the possibility of more than one co integrating relationship. This requires a new test for co integration and a generalization of the error-correction model to include multiple error-correction terms.

If two I(1) series x and y are co integrated, there is exist unique α_0 and α_1 such that $u_t = y_t - \alpha_0 - \alpha_1 X_t$ is $I(0)$.

In the single-equation model of co integration where we thought of y as the dependent variable and x as an exogenous regressor, we saw that the error-correction model

$$\Delta y_t = \beta_0 + \beta_1 \Delta X_t + \lambda u_{t-1} = \beta_0 + \beta_1 \Delta X_{t-1} + \lambda(y_{t-1} - \alpha_0 - \alpha_1 X_{t-1}) + u_t \qquad (1)$$

was an appropriate specification. All terms in equation (1) are $I(0)$ as long as the α coefficients (the "co integrating vector") are known or at least consistently estimated. The term is the magnitude by which y was above or below its long-run equilibrium value in the previous period. The coefficient λ represents the amount of "correction" of this period -$(t - 1)$ disequilibrium that happens in period t. In the two-variable case, there can be only one co integrating relationship and the y equation of the VEC system is similar to (1), except that we mirror the VAR specification by putting lagged differences of y and x on the right-hand side. With only one lagged difference (there can be more) the bivariate VEC can be written

$$\Delta Y_t = \beta_{y0} + \beta_{yy1} \Delta Y_{t-1} + \beta_{yx1} \Delta X_{t-1} + \lambda_y (Y_{t-1} - \alpha_0 - \alpha_1 X_{t-1}) + v^y_t \qquad (2)$$

$$\Delta X_t = \beta_{x0} + \beta_{xx1} X_{t-1} + \beta_{xy1} \Delta Y_{t-1} + \lambda_x (Y_{t-1} - \alpha_0 - \alpha_1 X_{t-1}) + v^x_t \qquad (3)$$

All of the terms in both equations of (2) are I(0) if the variables are co integrated with co integrating vector $(1 - \alpha_0 - \alpha_1)$, in other word, if $y_t - \alpha_0 - \alpha_1 X_{t-1}$ is stationary. The λ coefficients are again the error correction coefficients, measuring the response of each variable to the degree of deviation from long-run equilibrium in the previous period.

In the export function we consider all those factors that can potentially play a meaningful role in the determination of exports in the developing countries. Export promotion strategies have a great deal in trade liberalization regime. On one hand, developing countries are facing twin deficits, namely, fiscal deficit and trade deficit. On the other hand, external debt crises create further financial problems. In such sorry state of financial crises, the sole of FDI inflow is not sufficient. But the expansion of export sector for the improvement of financial disturbance also needs to be addressed. In this respect, we identify various determinants of exports. Foreign Direct Investment (FDI), Gross Domestic Product (GDP), Industrial value added (IVA) and Savings (SAV).

4. DATA ANALYSIS AND RESULT

The study employs econometric technique of Johansen co-integration and Vector error correction modelling (VECM) in order to estimate the model for export in Rwanda.

In the first step, the variables are tested for stationary using Augmented Dickey-Fuller (ADF) tests as a pre-testing device for co-integration. It has been carried out in order to determine the degree of stationary and overcomes the problems of spurious regression. Co-integration analysis on the other hand provided the potential information about long- term equilibrium relationship of the model. Structural stability and diagnostic testing procedure have been carried out in order to determine the behaviour of the export function in Rwanda.

Table 1: ADF Tests for Unit Roots (Order of Integration)

Variables	ADF	Model specification	Max lag	t-statistic	Order of integration
LEXPO	LEVEL	Intercept	9	-1.619078	
		Trend and intercept	9	-1.512980	I(1)
	1st DIFFERENCE	Intercept	9	-7.333333***	
LFDI	LEVEL	Intercept	9	-3.887553***	I(0)
LGDP	LEVEL	Intercept	9	-0.276277	
		Trend and intercept	9	-1.391875	I(1)
	1st DIFFERENCE	Intercept	9	-6.231934***	
LIVA	LEVEL	Intercept	9	-0.944295	I(1)
		Trend and intercept	9	-1.393303	
	1st DIFFERENCE	Intercept	9	-6.473805***	
LSAV	LEVEL	Intercept	9	-2.563991	I(1)
		Trend and intercept	9	-2.549960	
	1st DIFFERENCE	Intercept	9	-6.870193***	
Auxiliary regression with intercept					
Test Critical value:1% Level:-3.626784 ; 5% Level:-2.945842 ;10% Level:-2.611531					
Auxiliary regression with intercept and trend					
Test Critical value:1% Level:-4.226815 ; 5% Level:-3.536601 ;10% Level:-3.200320					

Source:author's compilation and values obtained from Eviews7

*** indicates rejection of the null hypothesis of unit root at 5% significant level, respectively

Table 1 Shows that the 4 series Export (EXPO), Gross Domestic Product (GDP), Industrial value added (IVA) and Savings (SAV) were found to be non-stationary at level. After differencing data the unit root test show that the series became stationary, it means the series are found to be integrated of order one i.e I(1) . To the other side Foreign Direct Investment (FDI) become stationary at level. The co-integration is possible because we found that among five series, four are co integrated.

4.1 Lag Length Selection process:

The criterion for selecting the lag length consists of important step. The information criteria are often used as a guide in model selection. There are different tests that would indicate the optimal number of lags. The study utilizes the AIC and HQ information criterion to ensure sufficient power to the Johansen procedure. The following table display the results.

Table 2: Lag Length Selection

VAR Lag Order Selection Criteria						
Endogenous variables: LEXPO LFDI LGDP LIVA LSAV						
Exogenous variables: C						
Date: 04/09/16 Time: 11:30						
Sample: 1976 2013						
Included observations: 34						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-67.81289	NA	4.99e-05	4.283111	4.507576	4.359660
1	71.71134	229.8046*	6.03e-08	-2.453608	-1.106820*	-1.994315
2	97.48578	34.87129	6.38e-08	-2.499163	-0.030051	-1.657125
3	131.6086	36.13001	4.94e-08	-3.035798	0.555639	-1.811015
4	178.6934	36.00602	2.54e-08*	-4.334903*	0.378857	-2.727376*
* indicates lag order selected by the criterion						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

The results from table 2 shows that Lag Length Selected is four as it is indicated by AIC and HQ information criterion. Since among 3 information criterion (Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion) as it was indicated by the last 3 culumns in the table above ,2 information criterion conform that the selected lag is 4.

4.2 Number of Co-integrated Vectors:

At this step, the study has found number of co-integrated equations using trace statistics and maximum eigenvalue statistics. According to probabilities given in tables three and four, the analysis rejects the null hypothesis that there is no co-integrated vector (None); there are at most 1,2,3,4 co-integrated vectors. It means that there are 5 co-integrated vectors in long run results. It shows high association between explanatory and dependent variables used in current study. More details are found in below tables.

Table 3: Johansen co-integrated vectors indicated by Trace

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.976356	278.7184	79.34145	0.0000
At most 1 *	0.899870	155.1445	55.24578	0.0000
At most 2 *	0.788334	79.20211	35.01090	0.0000
At most 3 *	0.455369	27.96149	18.39771	0.0017
At most 4 *	0.213113	7.909151	3.841466	0.0049
Trace test indicates 5 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 2:Johansen co-integrated vectors indicated by Max-eigen value.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.976356	123.5740	37.16359	0.0000
At most 1 *	0.899870	75.94237	30.81507	0.0000
At most 2 *	0.788334	51.24062	24.25202	0.0000
At most 3 *	0.455369	20.05233	17.14769	0.0184
At most 4 *	0.213113	7.909151	3.841466	0.0049
Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Tables 3 and table 4 indicate five possible co-integrating equations at the 0.05 level. These results give an indication for the existence of a long-run relationship between exports (EXPO), Foreign Direct Investment (FDI), Gross Domestic Product (GDP), and Industrial value added (IVA) and Savings (SAV).since all probabilities are less than 0.05. In other word this indicates that each variable among the five variables can be explained variable for others.

4.3 Johansen Long run estimates equation:

Table 3: Normalized co-integrated coefficients for long-run

Normalized cointegrating coefficients (standard error in parentheses)				
LEXPO	LFDI	LGDP	LIVA	LSAV
1.000000	-0.617189	-5.688742	4.230177	0.626657
	(0.04225)	(0.41494)	(0.22985)	(0.05748)

Based on table 5, the final preferred long-run equation using the full sample period is as follows, with their respective coefficients and standard errors in parenthesis.

$$LEXPO_t = -42.97 + 5.68 LRGDP_t - 4.23\ LIVA_t - 0.62 LSAV_t + 0.61 LFDI_t$$

$$(0.41) \qquad (0.22) \qquad (0.05) \qquad (0.04)$$

It is noticeable that all the coefficients in estimate Equation are statistically significant. The estimation results provide evidence of the complex dynamics and relatively long run effects that seem to exist between export and its explanatory variables which are consistent with theoretical postulates.

In literature the first and foremost determinant of exports is FDI. Our study finds positive and significant impact of FDI on export growth of Rwanda and 1% increase in FDI lead Export to be increased by 0.61%. The success stories of East and South East Asian countries suggest that FDI is a powerful tool of export promotion because multinational companies (MNCs) through which most FDI is undertaken have the well-established contacts and the up-to-date information about foreign markets.

The effect of GDP on exports is highly significant with positive sign where 1% increase in GDP lead to an increase in exports by 5.68%. The level of production can be utilized at domestic and international level at the same time. The country has relative advantages for agriculture goods since most of its exports are agricultural goods.

They can exhaust benefits of lower cost production by export growth policies. Moreover, large size of GDP creates environments for investment decisions.

The industry value added variable is highly significant in explaining export growth with negative sign where 1% increase in industry value added lead to a decrease of export by 4.23%.

Industry value added comprises of value added in mining, manufacturing, construction, electricity, water, and gas. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.

Most of manufactured products in Rwanda are used for domestic consumption and their production utilizes imported input. The same case for construction materials which occupies higher rate of import among the imported goods for Rwanda .Mining products are exported while they are not finished product and will be imported again from abroad after being finished product with highest price than the one it was exported .All of these they constrain the value of export and this cases lead the country to remain facing deficit in balance of payment.

The results show that savings significant and has slight negative contribution to exports. Normally Higher savings should imply lower interest rates that promote investment opportunities because the investment is the key channel for export growth. This negative contribution is due to the use of highest rate of savings in importing goods for both the government to import goods for infrastructure construction as well as for local people to import consumption goods and construction good .Even though the government of Rwanda provide many incentives for export promotion strategies still have the challenges since it is not yet being able to produce the same products used to import. The other raison is that the other big part of savings they are short term based that are reserved for early future consumption but not for domestic investment. The above discussed effects keep the country staying in saving-investment and exports-imports gaps.

Generally, it is therefore seems that the above estimates confirm most of the empirical results found in the literatures. Then, the perspectives of Foreign Direct Investment, Gross Domestic Product, Industrial Value Added, and Savings in the economic system in Rwanda are the variables that guide the exports decision in the long run.

4.4 Vector Error Correction Model:

Once the long term relationship is obtained, it is interesting to estimate a partial adjustment model (or a short term relationship) between export and its effect under this study.

The most important thing in the short run results is speed of adjustment term (VECM). It shows how much time would be taken by the economy to reach at long run equilibrium. The size of the speed of adjustment (-0.80) shows that the economy will converge towards the long run equilibrium in approximately one year following a shock.

Table 4: Short-run relationship between variables

Variables	Coefficients	Standard error	t-statistic	Probability
CONSTANT	0.11	0.13	0.92	0.3791
$\Delta LRGDP_{t-1}$	-6.16	2.25	-2.28	0.0209***
ΔFDI_{t-1}	-0.49	0.15	-3.19	0.0097***
ΔIVA_{t-1}	4.58	1.26	3.62	0.0047***
$VECM_{t-1}$	-0.80	0.26	-3.08	0.0116***
R-squared=0.80				

*** indicates the significance of variables in short-run at 10%, 5% and 1% significance level, respectively compared with their probabilities.

The empirical results shows that Foreign Direct Investment, Gross Domestic Product, Industrial Value Added are statistically significant in short run. To the other side Savings is not statistically significant; this is because short term deposits are used for early future consumption but not for investment perspectives.

However Foreign Direct Investment, Gross Domestic Product shows a negative effect on export, this is because most of short term national output and production from FDI are used for domestic consumption and therefore reduce the rate of exports.

Also as most of Rwandan exports are the agricultural products, then changes in weather condition will automatically affect the level of expected export.

The value of R-squared (R^2) shows that about 80 % of the variation in exports is explained by the combined effect of all variables considered. It also indicates that the explanatory variables contribute significantly in explaining the exports activity. This is the indicator of a good model which can be used for policy implication.

4.5 Stability test:

Stability diagnostics to measure parameter constancy is a critical issue for export equations. In particular, to be able to interpret the estimated equation as an export equation, it is necessary to assure that the parameters are stable over the estimation period. To achieve this, the study implemented the methodology based on the cumulative sum (CUSUM) tests proposed by Brown et al. (1975). The advantage of such a test over some other tests (Like Chow test) is that the former test requires the specification of the break points, while the latter test uses the cumulative sum of recursive residuals based on the first n observations and is updated recursively and plotted against break point (Ouattara, 2004).

The decision about the parameter stability relies on the position of the plot relative to the 5% critical bound. The CUSUM test is based on the cumulative recursive sum of recursive residuals. The CUSUM test statistics is updated recursively and plotted against break points in the data. For stability of the short-run dynamics and the long-run parameters of the export function, it is important that the CUSUM statistics stay within the 5% critical bound (represented by two straight lines whose equations are detailed in Brown et al., 1975 aforementioned). A graphical presentation of these tests is provided in Figures below.
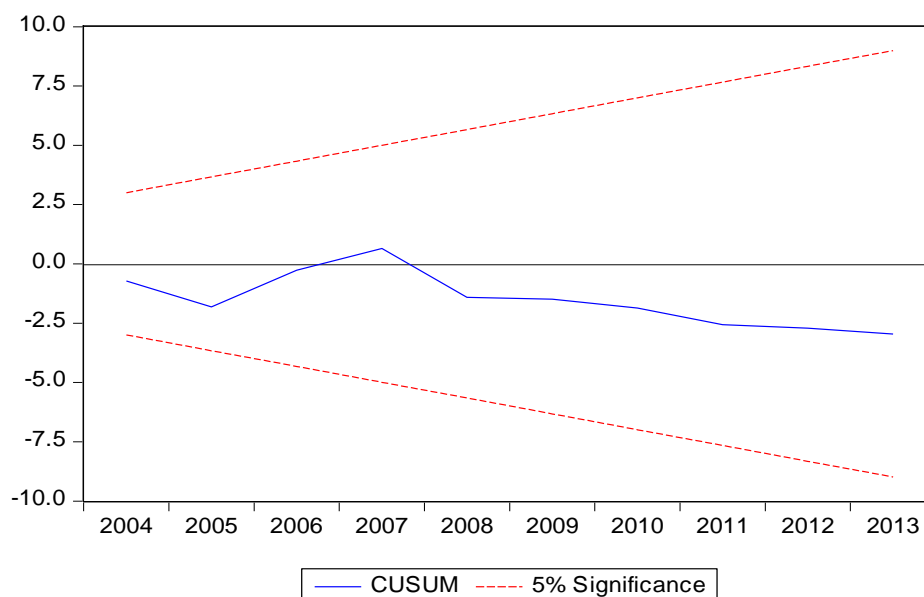

Figure 1: Cusum test for the stability.

As it can be seen from Figures above, the CUSUM plots doesn't cross the 5% critical lines, therefore, we can safely conclude that the estimated parameters for the short-run dynamics and long-run of the export function in Rwanda are stable. Thus the results are appropriate for policy implications.

4.6. Diagnostic test:

After estimating the VEC equation and parameter stability ,the supplementary tests such as normality, ARCH heteroscedasticity and serial correlation test are necessary to verify if the hypothesis of classical regression are confirmed.

4.6.1. Normality test:

The assumptions of this test are as follows:

Ho (null hypothesis): The residuals are normally distributed.

The null hypothesis is rejected when the probability is less than 10%.

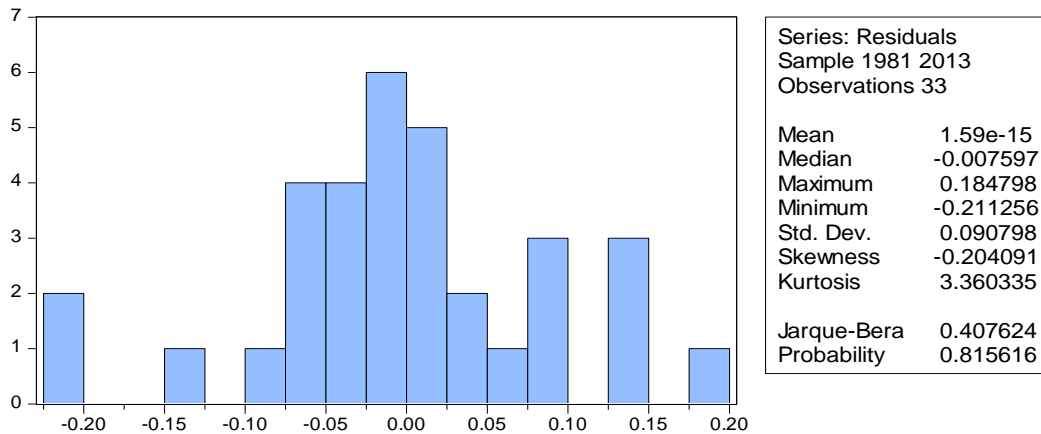The result of this test arises on the graph below:

Figure 2: Jarque-bera test for normality test

The null hypothesis is not rejected means that residuals are normally distributed because the Jarque-Bera probability of 81% is greater than the significant level of 5%.

4.6.2 Heteroscedasticity test:

The assumptions of this test are as follows:

Ho= the model is homocedastic

The null hypothesis is rejected when the probability is less than 10%.

Table 5: ARCH heteroscedasticity test

Heteroskedasticity Test: ARCH			
F-statistic	0.281105	Prob. F(1,30)	0.5999
Obs*R-squared	0.297062	Prob. Chi-Square(1)	0.5857

ARCH test for heteroscedasticity proves that there is no heteroscedasticity as the probability of obs*R-squared equal to 58% is greater than 5% level of significance. This means that our model is homoscedastic i.e constant variance.

4.6.3. Autocorrelation test:

The assumptions of this test are as follows:

Ho: No auto correlation (errors are not auto-correlated).

The null hypothesis is rejected when the probability is less than 5%.

Table 6: Autocorrelation test

The results show that there is no autocorrelation between errors up to the 16th lag, because probability is greater than 5% level of significance. We do not reject the null hypothesis. It means errors are not auto correlated at the same highest order which is order one in our case.

5. CONCLUSIONS

The objective of this study has been to find out the appropriate vector error correction model for modeling export in Rwanda. For this purpose the study used a fairly large sample of time series observations for the period 1976-2013. The data are derived from the World Development Indicators (WDI).

Vector error correction model is employed for the estimation of the relationship of exports with its potential determinants based on the data.

The error correction term VECM was significant and as required by the stability condition of the dynamic model, its sign was negative. This fact confirms the existence of cointegration among the variables of the model and convergence towards long run equilibrium. The study found the value of R-squared of 80% which means that the independent variables explain the dependent variable 80% , this is the indication of good model i.e. the model can be used by policy makers.

For checking if there is any structural change in the data, a stability tests were implemented using CUSUM test. The results of this test have shown that the parameters of the equation are stable, which in turn implies that we cannot reject the null hypothesis of constant parameters for the whole period of study at 5% level of significance. To test the structure of residuals, diagnostic test was carried out and did not reject null hypothesis that residuals are normally distributed, there is no auto-correlation between errors and the model is homoscedastic.

A number of conclusions can be drawn from the study, which is summarized as follows:

The null hypotheses are all rejected and were proved that there is a significant relationship between determinants and export, vector error correction model is a good fit of the data and all parameters to be estimated are adequate. Therefore the objectives of the study were achieved.

REFERENCES

[1] Alvarez, R.E. (2002). "Determinants of Firm Export Performance in a Less Developed Country", Anderson Graduate of Management, UCLA Asteriou, D. and Hall, S.G. (2007) *Applied Econometrics: A Modern Approach Using Eviews and Microfit*, Revised Edition. Palgrave Macmillan.

[2] Agasha, N (2006) .Determinants of Export Growth rate in Uganda (1987-2006)

[3] Asteriou (2007) Applied Economics: A modern Approach Using Eviews and Microfit, Revised Edition. Palgrave Mcmilla

[4] Balassa, B. (1990). Incentive policies and export performance in Sub-Saharan Africa. World Devolopment 18(3), PP383-391.

[5] Bigenimana, J (2014). Dynamic effect of lending internet rate, Output and other determination on Investment in Rwanda, Kigali Independent University.

[6] BNR (2013), Annual Report

[7] Cline, W.R.(2004). "Trade policy and Global Poverty", Washington Centre for Global Development, Institute for International Economics.

[8] Dewet, J.HvH and Mpinda (2013). The impact of dividend payment on shareholders' wealth: Evidence from the vector error correction model. International business and economics research journal, vol 12, no 11, pp1451-1466.

[9] Engle, R.F and Granger, C.W.J (1987) Co-integretation and Error correction Estimates .Representation , Estimation and Testing, Econometrica,vol-55 P251-276 Engle RF, Yoo B (1987): Co integrated Economic time series: A survey with new result in Granger CWJ, Engle RF (eds).Long run economic relations. Readings in Co integration. Oxford

[10] Granger CWJ(1981). Co integrated variables and error correction models. UCSD discussion paper 83-13a

[11] Gujarati, D.N. (2003) *Basic Econometrics*, 4th Edition, McGraw-Hill.

[12] Gujarati, D.N. (2011) *Econometrics by Example*, 1st Edition, Palgrave Macmillan.

[13] Haddad, M, and Harrison, A.(1993).Are these spillovers from direct foreign investment? Journal of Development economic, 42, pp51-74

[14] Hoeman,B and S. Djankov (1998) Determining of export structure of countries in central and Eastern Europe. The World Bank Economic review 11:3,471-487

[15] Horkman B, and Djunkov,P(1997). International Economics. The Lehigh Press Inc, New York

[16] Jacob, M (1991): Rwandan Paper on food crop marketing (World Bank, May 1990)

[17] Johansen (2010). Statistical Analysis of co integration vectors. Journal of Economic Dynamic and control

[18] Johansen, S.and Juselius ,K (1990). Maximum likehood Estimation and inference on cointegration with application for the demand for Money , Oxford Bulletin of economics and statistics, Vol 52,PP169-210

[19] Karimi, M.S. (2003). Non-oil export supply model in Iran. Paper Submitted to European Regional

[20] Kumar.J., and Siddharthan,N.S. (1997). "Technology, Market Structure and Internationalisation" Paper 816, Yale University.

[21] Mc Nees S.(1986) Forecasting Accuracy of alternative techniques. A comparison of Us Macro-economic forecasts, Journal of Business and Economic statics, Vol 4,PP5-15

[22] Menji (2010) , Export Performance and determinants in Ethiopia, and MPRA Paper N^O 29427, Addis Abeba, Ethiopia

[23] Mohamoud, E (1984) . Accuracy in forecasting. A survey , Journal of forecasting , Vol 3 PP (39-159)

[24] Ngeno, K.N (1996). Comparative analysis of economic reform and structural adjustment programme in Eastern Africa with emphasis on trade policies. Techno serve/university of Nairobi, technical paper no. 19 and 20, Nairobi, Kenya.

[25] Nguyen (2009). Forecasting and Data Analysis in Economics and finance, Statistical publishing house

[26] Ndulu, B. J and Lipumba N, H.I(1990). International trade and economic development in Tanzania: In trade and development in sub-Saharan Africa. Manchester university press.

[27] Phillips and Perron (1988).Testing for a unit root in time series regression. Biometrica, vol 75,No 2,PP335-346

[28] Phillips,P.C.B and S.Ouliaris(1988). Testing for co integration using principal components methods. Journal of Economic dynamics and control,12,205-230

[29] Quattara, B (2004). Modeling the Long run determinants of private investment in Senegal. Manchester School of Economics Discussion Papers , Series 0413

[30] Rodrick. D (1999). The new global economy and developing countries making openness work. Overseas development council, Washington.

[31] Ruggiero, R (1996).Foreign Direct Investment and the multinational Trade system. Transnational corporation,5,1-18

[32] Santos-Paulino,A.(2002).Trade Liberation and Export Performance in Selected Developing Countries. Journal of Development studies,volume 39,pp140-164

[33] Sekkat,K and Varoudakis,A (2000). Incentive policies and manufactured Exports in North Africa. Working papers 9922.Economic research forum.

[34] Shawtari FA, et all (2015). Long Run relationship between macroeconomic indicators and stock price. The case of South Africa. J internet bank commerce

[35] Stock,J.H and Watson ,M.W(1988). Introduction to econometrics,2nd edition, Pearson Education

[36] Todaro e(2009). Economic Development Pearson education limited.

[37] Wignaraja, G. (2002). Firm size, technology capabilities and market-oriented policies in Mauritius. Oxford Development studies 30(1):87-04