Effect of Foreign Aid on Real Exchange Rate in Rwanda

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Abstract

This study examines the effect of foreign aid inflows on the real exchange rate in Rwanda. It uses annual time series data for the period of 1980 to 2013. The main hypotheses of the study is that large foreign aid inflows in Rwanda lead to the appreciation of the real exchange rate and thus, impact negatively on exports competitiveness, a phenomenon known as the Dutch disease effect.

To test the research hypothesizes; the Johansen cointegration techniques and the vector error correction model were used to estimate the long run equilibrium and the short run real exchange rate respectively. Although Rwanda received considerable foreign aid inflows within the period under study, the estimated model results suggest that the country foreign assistance depreciates the real exchange rate. In order words, foreign aid inflows have a positive impact on the real exchange rate in Rwanda. However, the research reveals that there is no long run relationship between foreign aid inflows and Rwanda exports, meaning that exports in Rwanda have other determinants, which are not foreign aid inflows. The results of the study suggest that Rwanda can still receive foreign aid as they do not harm exports competitiveness. They should however be used in the provision of the public goods. In addition, given the fact that trade openness appreciates the real exchange rate, Rwanda can continue the economic integration process with other economies in Africa and the rest of the world.

Key words: Foreign aid, Real Exchange Rate and Export

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1. Introduction

Low income countries face the problem of low level of domestic savings which are insufficient for them to finance their desired investment. Also export earnings from low income countries are not enough to finance imports of capital goods. As consequences, these countries become constrained in their ability to achieve their target growth rates. To overcome the problem above, developing countries run for foreign aid to finance their investments.

However, aid-recipient countries also need to spend aid wisely, which would require both economic management institutions and political processes for enforcing transparency and accountability. Aid only appears to be effective in countries with appropriate economic policies, that is, Aid works in a good environment. From this perspective, good policy is a necessary condition for aid effectiveness. Donors also have to adopt aid delivery mechanisms that promote ownership, transparency and stakeholders' participation in the development process (Santiso, 2001).

In fact, as quoted by Elbadawi et al. (2009), rapid aid surges like commodity-price booms could also pose serious challenges for macroeconomic stability, especially if they produce significant disequilibria in the real exchange rate (RER) and induce the well known "Dutch Disease" phenomenon. Dambisa (2009) sees Dutch disease as a term that describes how large inflows of money can kill off a country's export sector, by driving up home prices and thus making their goods too expensive for export. According to her, Aid has the same effect. Large dollar-denominated aid windfalls that envelop fragile developing economies cause the domestic currency to strengthen against foreign currencies. Analyzing the macroeconomic aspects of the effectiveness of foreign aid, Van (1986) points out that temporary aid flows lead to temporary appreciation of the real exchange rate and lead to a decline in the production of traded goods as well as exports.

Since 1994, Official Development Assistance (ODA) to Rwanda has played and continues to play an important role in supporting national efforts for national development and poverty reduction. Today, ODA in Rwanda complements domestic resources in supporting national priorities as articulated in Rwanda's Economic Development and Poverty Reduction Strategy (EDPRS). (MINECOFIN, 2013). According to the Organization for Economic Cooperation and Development (OECD, 2013), ODA to Rwanda have been fluctuating between 15% and 25% of GDP from 2001 to 2012 and providing as much as 40% to the national budget. These flows have played an important role in Rwanda's stellar growth performance since the mid-1990s. Therefore, as quoted by IMF, World Bank analysis confirmed in June 2012 that Rwanda continues to be at moderate risk of debt distress. However, a common concern is that, through higher inflows of aid, donor support leads to an appreciation of the real exchange rate that has an adverse impact on exports commonly referred to as the "Dutch Disease".

Yet there is another notion that foreign aid inflows will not lead to an appreciation of the real exchange rate when spent on traded goods, imported investment goods and on factors that are limited in supply (Berg et al., 2005). In this case, the import of capital goods will permit greater domestic investment, which then, can lead to export expansion (and increased competiveness) and growth.

In fact, theories and empirical evidence have presented different conclusions regarding the effects of foreign aid on real exchange rate to countries beneficiaries. Research findings such as Adenauer and Vagassky (1998); Aggrey (2011) supported the Dutch disease phenomenon as a result of foreign aid in countries beneficiaries whereas other research findings such as that for Nyoni (1998); Mayanja (2006) and Kallon (2014) found no Dutch disease as result of aid inflows. Thus, the long-term impact of foreign aid inflows on the real exchange rate can only be determined empirically.

Rwanda being one of aid beneficiary countries raises the question on whether these cash inflows result in Dutch disease or whether they stimulate export performance and economic growth in general as the level of the Rwandan francs exchange rate continues to be determined by the forces of demand and supply in the foreign exchange market. The issue was ignored by previous researchers, and this study intends to find out its state.

This study, seeks to develop an empirical model for the real exchange rate in Rwanda with special focus on the role of foreign aid. The paper then attempts to link this with an export performance model in order to identify policy implications and management issues. Generally, it is hypothesized that first, external aid inflows to Rwanda result in real exchange rate appreciations, and secondly, that exports do not respond positively to aid inflows and real exchange rate volatility.

2. Literature review

There is a large literature on the effect of resource booms or large resource inflows in different countries. The studies have come up with different results from which some of them support the Dutch disease model whereas others contract from it.

Farid and Mazhar (2011) examined Remittances, Dutch disease and Competitiveness in Pakistan economy. Their results indicated evidence for both spending and resource movement effects, both of them in the short as well as in the long run. Remittances caused an appreciation of the real exchange rates and loss of competitiveness of Pakistan's exports sector along with a concomitant rise in the share of the non-traded goods sector in the economy. A similar study carried out by Elbadawi et al. (2009) availed new evidence on the impact of aid and overvaluation on growth and exports using a sample of 83 countries from 1970 to 2004. They found that aid fosters growth (with decreasing returns) but induces overvaluation. Overvaluation reduces growth but the effect is ameliorated by financial development. Finally, they found new evidence on the negative impact of overvaluation on export diversification and sophistication.

Athukorala and Rajapatirana (2003) conducted a comparative study on capital inflows and the real exchange rate for the main capital importing countries in Asia and Latin America. Their study focused on the behavior of the real exchange rate in terms of private capital inflows, disaggregated into Foreign Direct Investment (FDI) and other capital flows, and a set of macroeconomic indicators. They found out that the real exchange rate appreciates with rising levels of other capital flows whereas increases in FDI lead to a depreciation of the real exchange rate. They further observed that the degree of appreciation associated with capital inflows was lower in the Asian countries compared to the Latin American

countries. The available empirical evidence suggested increases in capital inflows have for the most part caused the real exchange rate to appreciate.

Another study by Adenauer and Vagassky (1998) on the 4 CFA countries that included Burkina Faso, Togo, Senegal and Cote d'Ivoire during the period of 1980 -1993 also supports the Dutch Disease model as their findings found the real exchange rate appreciation and export sector contraction. White and Wignaraja (1992) study on Sri Lanka for the period of 1997-1988 using an econometric model and revealed that increased Aid inflows was one of the major factors besides the remittances that contributed to the real exchange rate appreciation and contracting of the tradable goods and services.

Weisman (1990) used the computable General equilibrium (CGE) model, investigated the impact of aid inflows to Papua New Guinea. He finds that aid inflows increased government spending, which in turn increased the prices of non-traded goods and services. Producers responded to the increase in prices of non-traded goods by increasing supply in this sector and shifting resource from the production of traded goods. Therefore, aid inflows brought about the "Dutch disease" effect that threatened the export earning of Papua New Guinea. Elbadawi (1999) investigated whether external aid helped or hindered export orientation in Africa and estimated the relationship between ODA, real exchange rates and non-traditional exports for a panel of 62 developing countries including 28 from Africa. He found out a substantial partial real exchange rate overvaluation in many African and non-African countries. Moreover, exceptionally he found that high aid dependent African countries had either experienced or likely to experience overall real exchange rate overvaluation.

As it is seen, all the above empirical literatures support fully the Dutch disease model except the case of Sri Lanka in which the appreciation of the real exchange rate lead to an expansion of the tradable sector of which this differs a bit from the Dutch disease. Kallon (2014) investigated the long-run relationship between foreign aid, the real exchange rate, the trade balance, and economic growth in Sierra Leone for the period from 1974 to 2005 and found no support for the Dutch Disease hypothesis of an inverse relationship between foreign aid and economic growth in aid-recipient countries. Ouattara *et al.* (2005), carried out a study to test whether aid inflows in Syria generate Dutch disease using time series data for the period 1965 to 1997 by means of newly developed technique to cointegration, the Auto Regressive Distributed Lag (ARDL), their study found no Dutch disease phenomenon neither in the long run nor in the short run. On the contrary, the results indicate that foreign aid flows are associated with depreciation of the real exchange rate. Aid inflows lead to real depreciation rather than appreciation, both in the short and long run.

A study carried by Sackey (2001) on Ghana during 1962–1996 finds that although aid dependence is quite high, aid inflows lead to depreciations in the real exchange rate. Aid inflows have also had a positive impact on export performance. Tareke (2005) also carried out a similar study on Ghana from 1970-2002 .Using the ARDL approach to co-integration on the REER model, the findings first of all showed that the aid inflows depreciate the real exchange rate .Secondly with the export model it was found that the aid inflows have a negative effect on the export performance of Ghana which is contradicting with some the findings of Sackey about the same country. Arhenful (2013), using the ordinary least squares method

of estimation, concluded that although foreign aid inflows to Ghana for the period 1970-2002 are quite high, foreign aid inflows have positive impact on the real exchange rate. In other words, foreign aid inflows lead to the depreciation of the cedi, implying that the Dutch Disease hypothesis of large foreign aid inflows is rejected in the case of Ghana. In terms of policy recommendation, his results suggested that Ghana can still receive aid without fear of harming its exports competitiveness. It is seen results carried out by Arhenful confirmed what were obtained by Tareke that aid inflows depreciate the real exchange rate in Ghana for the same period but they contradict on the issue of foreign aid and export competitiveness. According to Tareke, aid inflows have a negative effect on the export performance of Ghana whereas Arhenful recommended Ghana to still receiving aid without fear of it to harm its export competitiveness.

A study by Ouattara and Strobl (2004) on the relationship between aid inflows and the real exchange rate in the 12 countries of CFA franc zone using a dynamic panel analysis from the 1980- 2000, the results showed no Dutch disease phenomena. This differs from the earlier findings of study by Adenauer and Vagassky (1998) on 4 CFA countries which are part of the 12 countries by Ouattara and Strobl (2004).

Results of research from different countries differ on the issue of Dutch disease as seen on the above empirical literatures. In some countries the Dutch disease phenomenon has been supported whereas in other countries foreign inflows depreciate the Real exchange rate which contradicts the Dutch disease model. In some countries of East African Community (EAC), these kinds of researches have also been conducted and results differ from the country to another. In Rwanda, Habakurama (2014) analyzed the effect of foreign aid on trade balance in Rwanda using time series data spanning from 1982 to 2012. The study revealed that there is a negative effect of foreign aid on trade balance in Rwanda and a positive effect of exchange rate on trade balance in Rwanda. In addition, there are no much studies on the issue East African Community a part from a study conducted in three of five country members of this community which are Tanzania, Kenya, and Uganda. In Rwanda only the study of Habakurama (2014) has been conducted and has focused on effect of foreign aid on trade balance and not specifically effect of foreign aid on real exchange rate. This reason has been one of the motives for the researcher to conduct such kind of study for the case of Rwanda.

3. Methodology

By examining the impact of foreign aid on real exchange rate in Rwanda, two models are taken into consideration: Real exchange rate model and export model. In examining the impact of foreign aid on real exchange rate in Rwanda, the model to be considered is the real exchange rate which is a function of foreign aid. Economic theory states that increased foreign inflows into the country bring about real exchange rate appreciation. This model is required to test the hypothesis of the said theory. However, since foreign aid is not the only determinant of real exchange rate, there are other factors which must be taken into account as they also have an influence on it. By consolidating Mayanja' (2006) model and Otieno's (2013) model, the variables that affect the real exchange rate include the terms of trade, government consumption, technological progress, openness of the economy, growth of money supply as other explanatory variables.

The model of real exchange rate model is as follow:

$$Log(REER) = \alpha_0 + \alpha_1 Log(Aid)_t + \alpha_2 Log(TOT)_t + \alpha_3 Log(G)_t + \alpha_4 Log(TP)_t + \alpha_5 Log(Open)_t + \alpha_6 Log(M_2)_t + \varepsilon_t$$

Where:

RER: Real effective exchange rate
α_0: Constant term
$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$: Coefficients of explanatory variables
Log (Aid): Logarithm of Official development assistant
Log (TOT): Logarithm ofTerms of trade
Log (G): Logarithm of Government consumption
Log (TP): Logarithm of Technological progress
Log (Open): Logarithm of Openness of the economy
Log (M_2): Logarithm of Growth of money
ε: Error term

The model of export model helps to determine the relationship between the exports and the real exchange rate for the case of Rwanda .Referring to the theory discussed earlier; it suggests that the real exchange rate appreciation brings about the contraction of exports. So this export model will help in the testing of the hypothesis for the case of Rwanda. And to control the influence of other variables that also have an effect on the exports, the export model will include the other determinants of exports. Similarly in Mayanja (1998) and Otieno (2005), the export model includes the exports(X) as the dependent variable and the explanatory variables include the real effective exchange rate (REER), Gross domestic investment (GDI), and net Aid inflows (Aid). So, the export performance is given by:

$$Log(X)_t = \beta_0 + \beta_1 Log\ (RER)_t + \beta_2 Log\ (I)_t + \beta_3 Log\ (YTP)_t + \beta_4 Log\ (AID)_t + \varepsilon_t$$

Both variables of Real exchange rate and those for Export models are be described in this section. The real effective exchange rate (RER) is the price of traded goods relative to the price of non traded (domestic) goods. In the absence of readily available indices of tradable and non tradable prices, the real exchange rate has to be proxied by available domestic and world price indices and nominal exchange rates. Therefore,

$$REER = NER * \frac{Pd}{Pf} \quad \text{or} \quad REER = NER * \frac{Pf}{Pd}$$

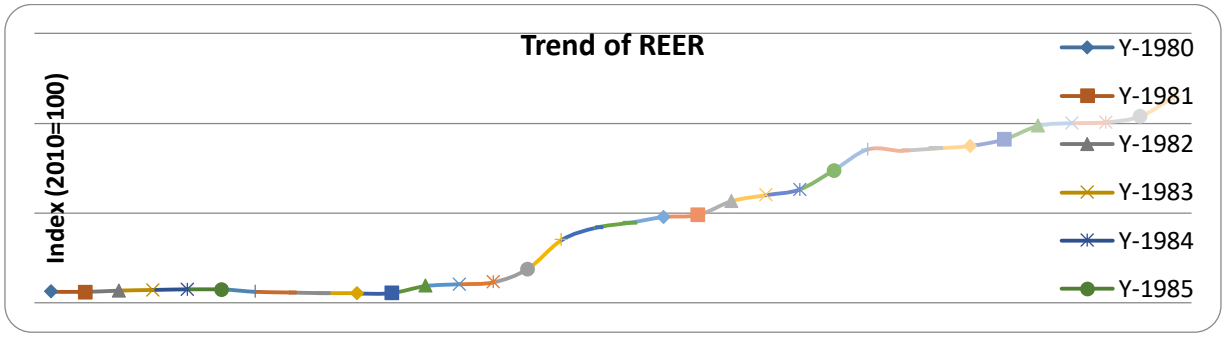
Where:

REER: Real effective exchange rate
NER: Nominal exchange rate (measured as domestic currency per foreign currency)
Pd: Domestic consumer price index
Pf: Foreign consumer price index

From the above equations, if any of them is used instead of the other it does not change their economic implication. The only difference is that for the first equation it implies that an increase in the REER corresponds to a real appreciation whereas for the second equation an increase in the REER corresponds to a real depreciation and vice versa. For our case we shall use the first equation in which an increase in REER corresponds to the real appreciation and where the decrease in REER corresponds to real depreciation. To construct our real exchange rate, the domestic prices will be presented by consumer

price index of Rwanda and proxy of foreign prices by consumer price index of trading partners. The trends of the real effective exchange rate as well as the other main variables are discussed in the paragraphs below.

Figure 1: Trend for Real effective exchange rate in Rwanda (1980-2013)



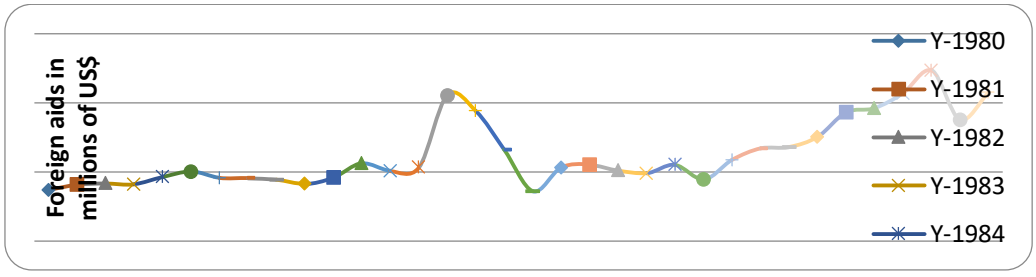
Source: Data compiled from WDI (2015)

The figure shows that from 1980 to 2013 there is an upward sloping of the trend of the real effective exchange rate and this means that there is appreciation of the real exchange rate within the period under study.

Terms of trade refers to the relationship between how much money a country pays for its imports and how much it brings in from exports. When the price of a country's exports increases over the price of its imports, it is said that the terms of trade has moved in a positive direction. The TOT is expressed as a ratio of import prices to export prices, that is, the amount of imported products/commodities that an economy can purchase, per unit of exported products/commodities. Any improvement that occurs in a country's TOT is beneficial to the economy because it means that the country can purchase more imports for the particular level of exports.

In this study official development assistance (ODA) inflows and official aid received will be used as the measurement for the Aid inflows. Net ODA consists of disbursements of loans made on concessional terms and grants by official agencies whereas net official aid refers to aid inflows from official donors.

Figure 3: Trends in ODA and official aid received by Rwanda (1980-2013)

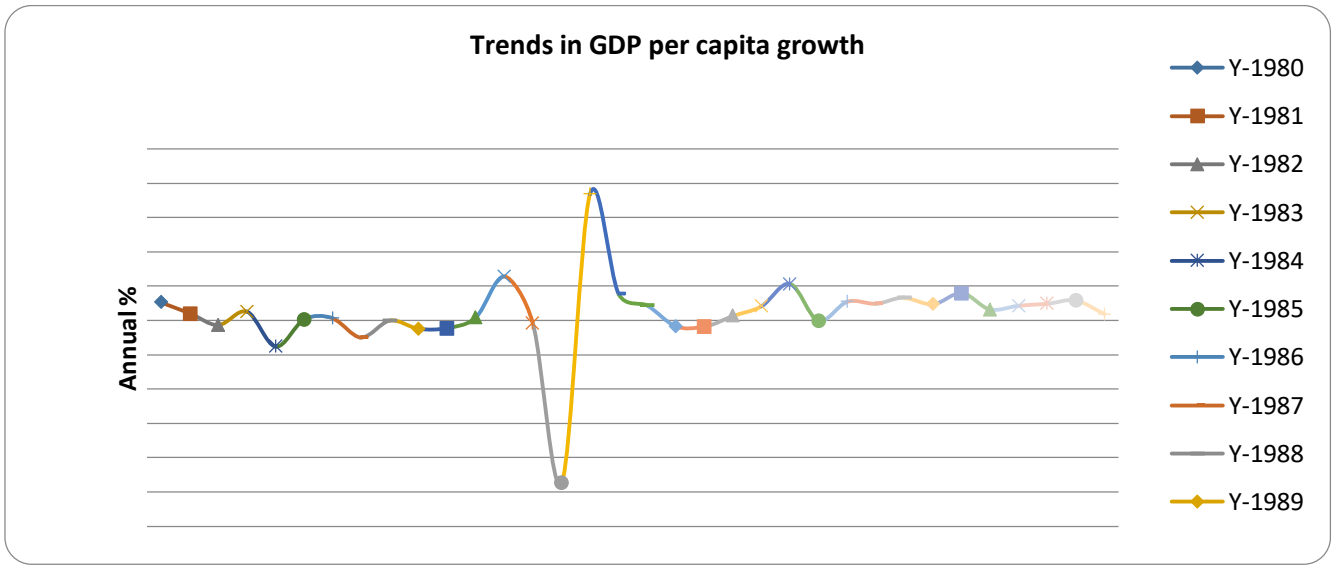


Source: Data compiled from WDI (2015)

The figure 3 shows that in general there has been an increase in foreign aid to Rwanda and especially in 1994 after the genocide. In 1997 there has been a decline in aid inflows as the country was accused to be in war in Republic democratic of Congo.
According to earlier discussion we expect the aid inflows to appreciate the real exchange rate. For the exports sector it will entirely depend on how the Aid inflows were used to end up with the positive or negative effect. So for this case the estimation results in the next section will tell us what the situation is, for the case of Rwanda with regard to the policy environment.

In this study the GDP per capita is used as a proxy for technological progress. This is based on the real exchange rate model developed by Edwards (1989). Although he used the real GDP growth as a proxy for technological progress rather than GDP per capita, the two can measure the productivity improvement of a country. Also the same measure of technological progress has been used by Victor and Dickson (2012) and Arhenful (2013). Its trends for Rwanda are given below:

Figure 5: GDP per Capita growth for Rwanda (1980-2013)

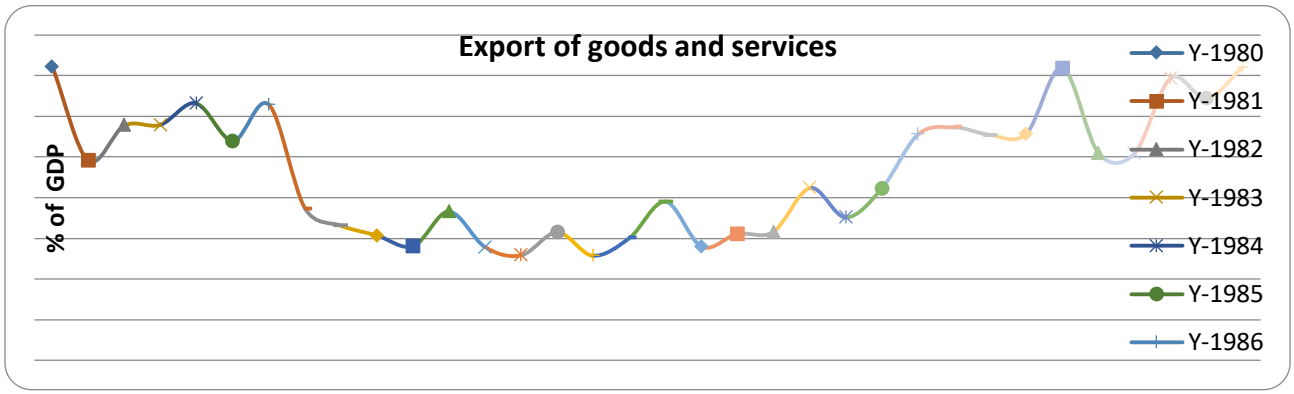


Source: Data compiled from WDI (2015)

Apart from the tragedy of 1994 during the genocide, the figure above demonstrates an average growth in GDP per capita of 2 percent per year. Its impact on real exchange rate will be discovered after the estimation of real exchange rate model, but it is possible to expect it to appreciate the real exchange rate as improvement in productivity is generally associated with tradable goods and services.

Export is a function of international trade whereby goods produced in one country are shipped to another country for future sale or trade. The sale of such goods adds to the producing nation's gross output. In this study, exports are measured as percentage of GDP and the figure below shows its trends for the case of Rwanda

Figure 6: Trend for export of Goods and services for Rwanda (1980-2013)



Source: Data compiled from WDI (2015)

The trend for figure 12 shows a general decreasing in the share of exports to GDP from 1980 up to 1995 and as discussed early, this pushes to expect a real exchange rate appreciation within that period. From 1996 to 2013 there is an upwards trend as exports share to GDP increased from 6 percent to at most 14 percent. This makes us expectant to have a depreciating real Exchange rate.

The study employs annual time series data from Rwanda over the period of 1980-2013. The data used to estimate the models are obtained from different sources. Most of variables such as Real effective exchange rate, foreign aid, terms of trade, gouvernement consumption, technological progress, exports, investment, and GDP for trading partners have been compiled from world bank world development indicators (WDI), 2015. Data like exports and imports to construct openness were obtained from World development indicators for the World Bank whereas GDP has been extracted from IMF. Finally, series for Money supply were extracted from National bank of Rwanda (BNR)

4. Results

For comparison purposes, we used both the Augmented Dikey-Fuller and Phillips Perron unit root tests were used.

Table 1: **Stationarity results of the Augmented Dickey-Fuller (ADF) test**

Order of integration	Variable	Intercept	Trend and Intercept	None
Level	LREER	-0.346	-1.952	1.459
1st difference	DLREER	-3.406**	-3.350*	-2.848***
Level	LAID	-1.751	-2.910	0.737
1st difference	DLAID	-6.021***	-5.925***	-6.002***
Level	LM_2	0.096	-2.236	4.520

1st difference	DLM_2	-6.442***	-6.399***	-2.099**
Level	TOT	-1.974	-2.003	-1.620*
1st difference	DTOT	-2.682*	-3.673*	-6.482***
Level	G	-3.886***	-4.062**	-0.485
1st difference	DG	-8.668***	-8.679***	-8.799***
Level	TP	-7.572***	-5.637***	-7.392***
Level	OPEN	-2.112	-3.913**	0.450
1st difference	DOPEN	-5.324***	-5.636***	-8.851***
1%	Critical values	-3.646	-4.273	-2.639
5%		-2.954	-3.558	-1.952
10%		-2.616	-3.212	-1.611

Source: Data compiled from Eviews 7

Values marked with *** represent stationary variables at 1% significance level;
Values marked by ** represent stationary variables at 5% significance level; and
Values marked by * represent stationary variables at 10% significance level

Table 2**: Stationarity results of the Phillips-Perron (PP) test**

Order of integration	**Variable**	**Intercept**	**Trend and Intercept**	**None**
Level	LREER	-0.512	-1.727	2.013
1st difference	DLREER	-3.406**	-3.350*	-2.869***
Level	LAID	-1.614	-2.877	3.018
1st difference	DLAID	-11.227***	-12.083***	-6.770***
Level	LM_2	0.198	-2.236	4.984
1st difference	DLM_2	-6.440***	-6.399***	-4.295***
Level	TOT	-1.975	-2.100	-1.643*

1st difference	DTOT	-6.487***	-6.552***	-6.434***
Level	G	-3.883***	-3.942**	-0.080
1st difference	DG	-10.231***	-12.658***	-10.577***
Level	TP	-7.811***	-16.360***	-7.682***
1st difference	DTP	-30.452***	-29.914***	-31.080***
Level	OPEN	-2.239	-3.907**	-0.063
1st difference	DOPEN	-8.954***	-9.610***	-8.956***
1%	Critical values	-3.646	-4.263	-2.637
5%		-2.954	-3.553	-1.951
10%		-2.616	-3.210	-1.611

Source: Data compiled from Eviews 7

Table 1 shows the Augmented Dickey-Fuller (ADF) results. The test has a null hypothesis of unit root. The calculated value of ADF was compared with the critical value. If the calculated value is greater than the critical, we then reject the null hypothesis that the series have unit root, thus confirming that the series are stationary. The ADF tests variables in intercept, intercept and trend and finally without trend or intercept. Considering variables in level, only technological progress (TP) is stationary at 1% significant level. All other variables become stationary after first difference.

Table 2 shows the Phillips-Peron (PP) results. According to Brooks (2008) ADF and PP tests are similar, but they incorporate an automatic correction to the Dickey-Fuller procedure to allow for auto correlated residuals. Considering variables in levels, the PP test revealed that only Technological progress (TP) is stationary at 1% significant level. Other variables are stationary when first differenced.
The two kinds of methods (ADF&PP) used to test for stationarity revealed that in general, the data series become stationary after first difference. Therefore, the series are integrated of the same order I (1).

After variables show that there are integrated of the same order, it is very important to determine whether a long run equilibrium relationship among them exist. Cointegration describes the existence of an equilibrium or stationarity relationship between two or more times series each of which is individually non stationary. For the purposes of this study cointegration examines the long run relationship between real exchange rate and its determinants. The cointegration approach allows integrating the long run and short run relationship between variables within a unified framework (Andren, 2007). In this study, the Johansen cointegration approach is preferred over the Engle and Granger residual-based methodology to test for cointegration because of the obvious reasons mentioned in the previous Chapter.

There are different tests that would indicate the optimal number of lags as required by the Johansen technique of co integration to show an indication of the lag order and the deterministic trend assumption of the VAR. Various lag length selection criteria are defined by different authors like, Akaike‟s (1969) final prediction error (FPE), Akaike Information Criterion (AIC) suggested by Akaike (1974), Schwarz Criterion (SC) (1978) and Hannan-Quinn Information Criterion (HQ) (1979). Table 4.2 shows the lag lengths selected by different information criteria.

Table 3: Lag order selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: LREER LM2 LAID G
OPEN TOT TP
Exogenous variables: C
Date: 09/09/15 Time: 10:03
Sample: 1980 2013
Included observations: 32

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-454.8943	NA	8130.646	28.86839	29.18902	28.97467
1	-269.8811	277.5197*	1.782847*	20.36757	22.93261*	21.21781*
2	-213.4968	59.90833	1.816575	19.90605*	24.71550	21.50025

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 3 confirms that the criteria selected 1 lag. Consequently, using the information criteria approach, the Johansen cointegration test was conducted using 1 lag for the VAR.

The trace test and maximum eigenvalue tests results based on the Johansen cointegration are shown in Table 4 and 5 correspondingly. For both methods if the test statistic is smaller than critical values of the tests we do not reject the null hypothesis of no cointegration.

Table 4: Johansen co-integration Rank Test (Trace)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.902208	210.0133	134.6780	0.0000
At most 1 *	0.757261	135.6161	103.8473	0.0001
At most 2 *	0.708042	90.31153	76.97277	0.0034
At most 3	0.441806	50.91491	54.07904	0.0930
At most 4	0.416419	32.25736	35.19275	0.1002
At most 5	0.276348	15.02307	20.26184	0.2250
At most 6	0.135865	4.672857	9.164546	0.3212

Trace test indicates 3 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 5: Johansen co-integration Rank Test (Maximum Eigenvalue)

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.902208	74.39721	47.07897	0.0000
At most 1 *	0.757261	45.30458	40.95680	0.0152
At most 2 *	0.708042	39.39661	34.80587	0.0132
At most 3	0.441806	18.65755	28.58808	0.5202
At most 4	0.416419	17.23429	22.29962	0.2194
At most 5	0.276348	10.35022	15.89210	0.3035
At most 6	0.135865	4.672857	9.164546	0.3212

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The trace test and maximum eigen value test reject the null hypothesis of no cointegration. Therefore, it can be concluded that there is a significant long run relationship between the given variables under study. The next in this study is to examine the long run response of real effective exchange rate to change in foreign aid, terms of trade, money supply, government consumption, technological progress, and openness of the economy.

Table 6: **Normalized cointegrated coefficients**

1 Cointegrating Equation(s):	Log likelihood	-281.3049

Normalized cointegrating coefficients (standard error in parentheses)

LREER	LM2	LAID	G	OPEN	TOT	TP	C
1.000000	-0.968152	1.737517	0.006003	-0.052447	0.012681	0.024777	-10.63768
	(0.02978)	(0.09774)	(0.01000)	(0.00475)	(0.00115)	(0.00346)	(0.51294)

Based on table 6 the long run effect of foreign aids on real exchange rate is given in equation below:

$$\mathbf{LREER=10.638 - 1.738LAid + 0.968LM_2 - 0.006G + 0.052Open - 0.013TOT -0.025TP+ \varepsilon_t}$$

From the above equation it is seen that variables such as M2 and Open have a positive long run relationship with REER. It means that they contribute in the appreciation of real exchange rate. The remaining of variables such as Aid, G, TOT, and TP have a negative long run relationship with REER. This means that they contribute in the depreciation of real exchange rate. All the variables are statistically significant in explaining the real exchange rate.

Focusing on the relationship between foreign aid and real exchange rate as the variable of interest of the study, results suggest that a one unit increase in foreign aid to Rwanda decreases the real exchange rate (which is depreciation) by 1.738 units every other thing remaining the same. This is normal as it is in line with some other research findings such as that for Nyoni (1998) for Tanzania, Ouattara *et al* (2005) for Syrie, Mayanja (2006) for Uganda, Kallon (2014) for the case of Sierra Leone. The fact that foreign aid inflows depreciate the real exchange rate in Rwanda witnesses that they are spent wisely, with transparency and accountability. This supports the null hypothesis of the study saying that foreign aid inflows to Rwanda do not result in real exchange rate appreciation.

In the long run, a one unit increase in government consumption decreases or depreciates the real exchange rate by 0.006 in Rwanda. Theories say that the effect of government consumption on real exchange rate depends on the composition of these expenditures, whether are spent on tradable or non tradable goods and services. They appreciate the real exchange rate if there are mostly spent on non tradable goods and services as in this case they let prices increase. In this study it is fine as we can conclude that most of government consumption is spent on tradable goods and services.

Results of the study also show that a one unit increase in terms of trade depreciates the real exchange rate by 0.013 in the long-run, ceteris paribus. A one unit increase in technological progress pushes the real exchange rate to depreciate in the long run by 0.025. This is normal and beneficial to Rwandan citizens because the general improvement in productivity increases income which also increases prices of non tradable goods and services but this continuous improvement in productivity leads to an increase in supply which on the other side reduces the demand for non tradable goods and services and consequently it is the reduction of their prices

Change in money supply appears as the significant determinant of real exchange rate in Rwanda with an expected positive relationship in the long run. A unit increases in money supply increases (appreciates) the real exchange rate by 0.968.
In this study, openness of the economy has a long run positive impact on the real exchange rate in Rwanda. In other words the situation of openness in Rwanda appreciates the real exchange rate. This raises an insight on the existence of some restrictions in Rwandan international trade.

If the time series are not stationary then the VAR framework needs to be modified to allow consistent estimation of the relationships among the series. The vector error correction (VEC) model is just a special case of the VAR for variables that are stationary in their differences (i.e., I (1))

As the cointegration relationship has been determined, the next step is to estimate the short-run real exchange rate function using Vector error correction model (VECM). The short-run model coefficients measure the dynamics of the model whereas VECM measures the speed of adjustment to the long run equilibrium which is taking place. The table 9 shows the results of short run model of real effective exchange rate.

Table 1: Short-run model of real effective exchange rate

Variable	**Coefficient**	**Standard error**	**T-statistic**	**Probability**
$\Delta LAID_{t-1}$	-0.268814	0.16163	-1.66313	0.244
$\Delta LM2_{t-1}$	0.131288	0.34124	0.38474	0.0177**
ΔG_{t-1}	0.015328	0.01216	1.26056	0.4049
$\Delta TOT_{\mathbf{t-1}}$	-0.011243	0.00394	-2.85164	0.0158**
ΔTP_{t-1}	0.016516	0.00655	2.52241	0.0182**
$\Delta Open_{t-1}$	-0.007685	0.01008	-0.76252	0.7443
VECM t-1	-0.287216	0.11061	-2.59660	0.0049*
Constant	0.155583	0.0541	2.87592	0.004*

Source: Data compiled from Eviews 7
*;**; and *** indicate the rejection of null hypothesis at 10%; 5% and 1% significant level respectively.
R-squared: 0.71 Prob (F-statistic): 0.040686

The error correction coefficient should be negative and statistically significant in order to guarantee that the divergences, which occur in one period, are corrected in the next period (Engle and Granger, 1987). This complies with the situation of our model as seen in table 4.5. Therefore, the coefficient of real effective exchange rate of -0.287216 shows that the speed of ajustement is approximately 28.7 percent. This means that if there is a deviation from equilibrium, only 28.7 percent is corrected in one year as the variable moves towards restoring equilibrium. It means that there is a considerable pressure on real exchange rate to restore long run equilibrium whenever there is a disturbance. The fact that the speed of adjustment is only 28.7 percent, it reflects the existence of other determinants of real exchange rate in Rwanda not specified in the model.

In this short run model, variables such as M_2, TOT and TP are statistically significant whereas LAID; G and Open are not statistically significant. This means that the formers have an influence on the real exchange rate in the short run and the later do not influence it in the short run.

In the short run a one unit increase in Money supply (M_2) increases the real exchange rate which is appreciation by approximately 0.131288. But if the terms of trade increase by one unit in the short run, the real exchange rate decreases by 0.011243 which is a depreciation of real exchange rate. Finally an increase of technological progress by one unit results in an increase of real exchange rate by about 0.016516.
The R-squared (R^2) of 71% indicates that determinants of real exchange rate chosen as explanatory variables contribute significantly in explaining it, and this is an indicator of a good model.

5. Conclusion and recommendations

The purpose of this study was to evaluate econometrically the effect of foreign aid on real exchange rate in Rwanda from 1980 to 2013. The first chapter was the general introduction to the study. From this chapter one all its necessary contents such as the background of the study, statement of the problem, objectives of the study, its hypotheses, scope, significance and organization of the study have been highlighted.

As the two models were already specified, the next step has been to deal with stationarity test for individual time series data for them to be assured if there are cointegrated. This has been achieved using Augmented dickey-fuller and Phillips-perron tests of unit roots. Both of tests showed that most of time series were no stationary in levels but all of them became stationary after first differencing. The long run and short run relationship among variables have been determined by means of Johansen cointegration and error correction methodology as preferred compared to Engle-Granger approach. Therefore, considering the first model, empirical findings revealed that there is a long run relationship between the real exchange rate and explanatory variables chosen for the case of Rwanda in the following manner:

The study found that foreign aid inflows lead to real depreciation of the real exchange rate rather than appreciation of the cedi. Hence, the hypothesis that foreign aid inflows generate “Dutch disease” is

rejected in the context of Rwanda. The coefficient of foreign aid was negative and statistically significant at 10 percent error level.

The coefficient of growth of money variable is positive and is significant at 5 percent error level. This implies that increases in the growth of money causes the real exchange rate to appreciate.

The coefficient of real government consumption is negative implying that increase in real government consumption causes the real exchange rate to depreciate. However, the coefficient is statistically significant at one percent level.

The impact of technological progress represented by per capita GDP is negative and is statistically significant at 1 percent error level, thus implying that higher income levels from the increase of production tends to decrease the real exchange rate.

The coefficient of degree of openness of the economy is positive and is highly significant at 1 percent error level. This result suggests that openness leads to an appreciation of the real exchange rate in Rwanda.

Finally, the coefficient of the terms of trade variable is negative and is statistically significant at 1 percent error level. This means that terms of trade negatively affects real exchange rate in Rwanda.

With regard to the export performance equation, the following findings were made:

The estimated coefficient of real exchange rate is negative implying that real exchange rate and exports are negatively related in Rwanda. However, this variable was not found to be significant even at 10 percent error level in the long run. This means that the real exchange rate is not a major determinant of exports in Rwanda.

The study also found that foreign aid inflows are positively related to exports performance. However, the estimated coefficient is not statistically significant in the long run implying that there is no direct meaningful relationship between foreign aid and export performance in Rwanda. In other words there are more relevant factors than these. Further researches can therefore be done for these factors.

Finally, the gross domestic investment variable is negative implying that it could be negatively related to the volume of exports but it is not also statistically significant even at 10 percent error level of significance.

Diagnostic tests were performed on the residuals to ensure that residuals were well behaved. Once the residuals are serially correlated and have no constant error variance, it may indicate that the model is not efficient and parameters estimated could be biased. These diagnostic tests have been implied on both real exchange rate model and export performance model and found that residuals are homoscedastic, normally distributed and without serial correlation. The CUSUM and CUSUMSQ tests for the survey of stability of both the short-run and long-run coefficient estimates, their graphical presentations reveal that the estimated coefficients are stable because neither statistic crosses the critical values represented by the two straight lines.

Since the aid inflows in Rwanda are associated with the depreciation of the real exchange rate, foreign aid still have positive effects and thus the Rwanda Government can continue to receive aid. However, foreign Aid inflows should continue to be directed towards the provision of public goods and spending on the imports that will stimulate the private sector productivity. In addition, since the growth of money supply has an appreciating effect on the real exchange rate, the National Bank of Rwanda should adopt contractionary monetary policy measures related. Finally, given the fact that trade openness appreciates the real exchange rate, Rwanda can continue to be integrated with other economies in Africa and the rest of the world.

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DATA USED IN REAL EFFECTIVE EXCHANGE RATE MODEL

Period	REER	Aid	TOT	G	TP	M2	Open
1980	36.23706524	368.41	89.92894847	12.49189732	5.302376143	14.1	40.68131051
1981	35.40413843	408.16	92.45754316	20.02617379	2.006468675	15.9	31.09542744
1982	39.52770802	416.02	66.03266802	12.90948271	-1.375911625	16.1	32.94614517
1983	41.68908977	409.45	61.49701257	11.75336993	2.584528198	18.0	29.37643779
1984	43.7369024	463.15	68.63202389	10.21048148	-7.613608476	19.8	32.86320886
1985	43.93942737	501.89	83.60339284	11.2701343	0.324714801	23.3	28.39615768
1986	36.88205868	455.1	73.77449867	11.94676501	0.640749156	26.4	30.31788657
1987	33.73999728	453.99	91.48940531	13.50864157	-4.990757165	29.2	24.61128218
1988	31.30514182	441.45	72.90064636	13.49041653	-0.02340102	31.3	23.25677531
1989	30.83296215	412.7	81.72825682	12.68727248	-2.4998917	30.0	21.62929879
1990	32.12697466	459.02	93.28746528	10.14096269	-2.276158858	31.8	20.15185084
1991	54.7699074	562.49	46.78234119	12.06533327	0.855033332	33.7	26.40232497
1992	60.65122449	506.77	41.68046902	14.4720628	12.8051233	37.9	24.79725563
1993	67.28828948	532.65	29.41927985	14.28611657	-0.855385739	37.9	26.91484461
1994	110.3910569	1055.11	10.14235211	11.24004768	-47.31422621	32.2	44.83703032
1995	205.127295	941	16.95967552	10.31337997	36.76702345	62.6	32.33542854
1996	244.5688938	659.92	23.27975511	11.49039925	7.692938529	69.8	33.17404628
1997	259.8062791	359.16	21.84127543	9.582661256	4.330004149	90.1	34.27375605
1998	278.9191262	529.92	20.39348823	10.04345689	-1.754873824	91.9	29.67983438
1999	285.3924136	552.21	25.97730272	13.91964356	-1.78044116	98.0	31.10088356
2000	330.0807722	510.17	21.31630724	11.64739448	1.318636556	119.5	31.50575941
2001	350.1922141	489.5	31.13950245	15.85904453	4.148203203	121.4	32.74882218
2002	368.365003	550.4	30.18720159	13.75252069	10.63700003	144.5	30.81325577
2003	430.6935145	443.72	40.03236661	13.13805542	-0.089905204	167.5	31.99964206
2004	499.06803	585.28	43.1320339	11.05446784	5.464733905	206.1	35.71589461
2005	494.2886845	670	45.45454545	18.19444444	4.926951863	246.2	36.54584611
2006	501.7760244	678.83	36.18205526	18.18181818	6.617848498	320.9	36.37916691
2007	509.4898549	753.88	33.44204594	16.12590799	4.716659509	425.2	36.08176054
2008	531.1131348	932.12	35.9238792	14.02973694	7.956667269	436.1	43.17297865
2009	574.9371904	961.1	26.81865978	14.41829632	3.172626322	440.1	38.34928294

2010	583.1309066	1069.44	29.00372224	14.86608486	4.271913309	544.1	39.30562188
2011	586.1590022	1235.03	32.08323356	13.65054602	4.875222446	561.3	43.47867281
2012	605.4923527	878.99	30.55583552	14.38556933	5.811896875	590.7	44.12838073
2013	670.0305056	1075.05	33.81517002	14.16529605	1.85132004	601.9	45.3902818

DATA USED IN EXPORT PERFORMANCE MODEL

Period	X	REER	Aid	GDI
1980	14.4365216	36.23706524	368.41	12.21409359
1981	9.825505522	35.40413843	408.16	13.03000684
1982	11.55255878	39.52770802	416.02	14.34200208
1983	11.58176752	41.68908977	409.45	14.5855164
1984	12.63143363	43.7369024	463.15	15.49987051
1985	10.78250667	43.93942737	501.89	15.57127682
1986	12.58431789	36.88205868	455.1	15.73391982
1987	7.450052531	33.73999728	453.99	15.70602772
1988	6.619559833	31.30514182	441.45	13.95019941
1989	6.139288957	30.83296215	412.7	13.35182985
1990	5.614609178	32.12697466	459.02	14.64998321
1991	7.31660444	54.7699074	562.49	14.02174997
1992	5.568408197	60.65122449	506.77	15.63409605
1993	5.175245964	67.28828948	532.65	16.74702087
1994	6.30258592	110.3910569	1055.11	9.982508993
1995	5.150791919	205.127295	941	13.409133
1996	6.031370025	244.5688938	659.92	14.37042637
1997	7.797339371	259.8062791	359.16	13.80977944
1998	5.585063573	278.9191262	529.92	14.80766113
1999	6.222051113	285.3924136	552.21	13.14875239
2000	6.319815445	330.0807722	510.17	13.37598057
2001	8.478552336	350.1922141	489.5	13.73552437
2002	7.035364936	368.365003	550.4	13.48131427
2003	8.453400504	430.6935145	443.72	13.85390428
2004	11.12400531	499.06803	585.28	15.02818302
2005	11.45833333	494.2886845	670	15.76388889
2006	11.07226107	501.7760244	678.83	16.02564103
2007	11.13801453	509.4898549	753.88	18.2566586
2008	14.37285551	531.1131348	932.12	23.48455966
2009	10.1756712	574.9371904	961.1	22.96983759
2010	10.17153175	583.1309066	1069.44	22.50978032
2011	13.85855434	586.1590022	1235.03	22.8549142
2012	12.87485908	605.4923527	878.99	25.05073281
2013	14.41200658	670.0305056	1075.05	25.53453947