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Re-assessing Rwanda's Exchange Rate and External Sector Competitiveness

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Abstract

This paper re-assesses Rwanda's real exchange rate and external sector competitiveness using three complementary approaches proposed by the IMF's consultative group on exchange rate issues (CGER). We use quarterly data, covering the period 2000Q1-2020Q4 and 5-year period medium term projections. In terms of estimation strategy, we employ a triangulation of methods, including ordinary least squares (OLS) to estimate current account determination model and the estimation of trade semi-elasticities and for the reduced form equilibrium exchange rate (ERER) model, particularly the behavioral equilibrium exchange rate (BEER) model, we use dynamic ordinary least squares (DOLS) along with its complementary estimators such as fully modified ordinary least squares (FMOLS) and Canonical cointegration regression (CCR) as robustness checks. For the external sustainability (ES) model, we rely on trade elasticities obtained from the first model together with a few assumptions relating to economy's potential growth rate and inflation rate. The results indicate that the current account and the RER are influenced by economic fundamentals. The estimated exchange rate misalignment levels from the three approaches point to the same direction. The current research obtains an average exchange rate gap for the three models of 13.4 percent, implying that Rwandan currency is overvalued in real effective terms by 13.4 percent, pointing to adverse effects on the external competitiveness. The important policy implications arising out of these empirical findings include maintaining exchange rate flexibility to cushion adverse external shocks, but also effective monitoring of exchange rate developments remains vital to avoid higher levels of volatility which could lead to poor performance of the country's tradable sector.

KeyWords: Exchange Rate Misalignment, Dynamic Ordinary Least squares.
JEL Classification Numbers: F41, C22.

1. Introduction

In an increasingly integrated global economy, the exchange rates play a pivotal role in many countries' external sector competitiveness and ensuring macroeconomic performance and stability (Nuwagira and Kigabo, 2014). In order to appraise a country's competiveness position, it is preferable to examine the deviation of its Real Exchange Rate (RER) from an estimated benchmark or equilibrium level, as referred to the misalignment conditions. It is known that significant and persistent RER misalignments have implications on the country's potential economy, hence it increases its vulnerability (Jongwanich, 2009).

There are several studies on the three methodologies of the External Sector Assessment, developed by the IMF's Consultative Group on Exchange Rate Issues (CGER) and followed by the Research Department, namely the Macroeconomic Balance (MB), the reduced-form Equilibrium Real Exchange Rate (ERER) and the External Sustainability (ES) (Cubeddu, 2018) . According to IMF, these models help to review countries' international competitiveness, with the aim to understand and evaluate the current account and exchange rate development, and their current relationship. Secondly is to estimate the current account determination model, based on the current macroeconomic fundamentals, and to indicate the level of exchange rate adjustment needed to reconcile the underlying current account and the current

account norm balances.

From the year 2010 to 2020, Rwanda's level of openness[1] increased significantly by 15.8 percentage points to 54.3 percent, where exports of goods and services recorded an average annual increase of 12.2 percent while imports of goods services registered an average increase of 8.7 percent. However, current account (CA) deficit increased by 5.6 percentage points, since the imports bill remain persistently higher than exports receipts. The CA deficit is financed by the Financial Account (FA) and the Capital Account (KA) flows that registered an average growth of 13.3 percent. As a result, the Net International Investment Position deteriorated. However, the nominal exchange rate against the dollar recorded annual depreciation of 4.7 percent for the period under review, with lower volatility compared to regional peer currencies. (Dvornak et al., 2003)

When the standard deviations of the nominal exchange rate of the East African Community (EAC-5) against the US dollar from 2000 to 2020 are computed, Rwanda's standard deviation is the lowest with 0.049, followed by that of Kenya and Tanzania, 0.054; Uganda with 0.073 and lastly Burundi with 0.077.

Studies on Rwanda External Sector Assessments are very few despite its crucial role on economic activities and external sector performance, since it helps to understand the relationship between Rwandan's international trade and the exchange rate development, and the adjustment gap of the tradable goods prices. For instance, Muvunyi et al. (2019) used the External Sustainability (ES) methodology to evaluate the Rwandan Current Account Deficit vulnerability to the level of Net Foreign Assets. Nuwagira and Muvunyi (2016) studied the impact of the real exchange rate on the Rwanda's external competitiveness, using the Behavioral Equilibrium Exchange Rate (BEER) method to determine the level of the exchange rate misalignment and proceeded to test the Marshall-Lerner condition.

In this paper, the main objective of this study is to re-assess Rwanda's real exchange rate and external sector competitiveness, based on the current account determination model and the reduced form real exchange rate determination model, along with the associated level of real exchange rate misalignment. While the two previous papers relied on just one method, the current assessment explores the three complementary methodologies suggested by the IMF to have different perspectives from the different methodologies, a key contribution of this paper.

Our main findings are the following. First, the results showed that the evolution of real exchange rate is mainly determined by Rwanda's openness, government expenditures, terms of trade and relative productivity (Balassa–Samuelson effect). The results from the reduced form equilibrium exchange rate revealed alternating episodes of undervaluation and overvaluation though the size of misalignment is not very high especially in the last decade. However, as assumed earlier, the recent overvaluation of the RER is much higher than that in the previous studies mentioned above. Specifically, the real exchange rate deviates from its long-term equilibrium by 7.6 percent. These results are similar with those from the external sustainability approach, which suggested a depreciation of 17.7 percent, meaning that the real exchange rate is overvalued and thus real exchange rate should depreciate by 17.7 percent to close the gap between the underlying current account deficit and the NFA stabilizing current account deficit. Lastly, the macroeconomic balance approach also suggested a 15.1 percent depreciation to close the gap between the underlying current account and the current account benchmark or norm.

The rest of the paper is structured as follows. Section 2 briefly discusses the theoretical and empirical literature on External Sector Assessment Methodologies. Section 3 describes the complementary approaches proposed by the IMF's CGER that are used in the current analysis. Section 4 estimates and discusses results. Section 5 draws up conclusions and recommendations.

2. Literature Review

The Macroeconomic Balance (MB) approach computes the difference between the projection of current account balance in the medium term at prevailing exchange rates and an estimated equilibrium current account balance, referred to as "CA norm. The adjustment on the exchange rate that would close the gap between the two current account balances is then estimated using prevailing country's macroeconomic fundamentals (Cubeddu, 2018)

Chinn and Prasad (2003) used the MB approach to determine the factors that directly and indirectly affect the current account fluctuations. They used cross-section and panel data models to 18 industrial and 71 developing countries, and the results show that the current account deficit is positively related to fiscal balance and international investment position deficit, with an addition case of developing countries of which the dependence of foreign financial inflows positively affect the current account. On the other hand, the countries' level of openness tends to negatively affect the current account balance.

Dvornak et al. (2003) applied the MB approach in Australia; to determine the medium-term macroeconomic factors that affect the exchange rate, i.e. its relationship

[1] Openness is measured as exports plus imports divided by GDP

Table 1: Summary of Rwanda External Sector Statistics

	2010	**2012**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
CA % GDP	-6.5	-9.7	-12.7	-15.3	-9.5	-10.1	-11.9	-12.1
Credit % GDP	22.2	24.1	24.3	24.6	28.2	29.2	28.3	25.8
Debit % GDP	28.7	33.8	37.0	39.9	37.6	39.3	40.2	37.8
Openness % GDP	38.3	45.7	51.4	52.6	53.8	55.8	57.9	54.1
FA & KA % GDP	8.2	7.9	9.1	12.5	9.5	10.9	11.5	14.0
IIP net % GDP			-36.6	-42.6	-47.0	-51.0	-56.2	-68.0
Assets % GDP			15.5	18.3	19.1	21.1	20.2	24.2
Liabilities % GDP			52.1	60.8	66.1	72.1	76.4	92.2
Reserves Coverage (months)	4.5	4.1	3.6	3.9	4.2	4.5	5.9	5.9
Nominal ER (% Change)	2.6	2.3	5.4	9.4	5.6	3.6	4.5	4.9
T-o-T (index 2017 = 100)	161.0	104.6	89.0	91.9	100.0	97.4	85.7	83.9

with the current account. They have started with two hypotheses; firstly, is that the internal macroeconomic balance is achieved with the economy is performing at the potential level, secondly, the external balance is achieved when the exchange of flows (current and financial flows) between two countries are on equilibrium, no matter how their individual current accounts are performing. In their empirical analysis, they estimate how elasticities between the current account and the output for Australia, then the estimate the exchange rate adjustment to reduce the gap between the current national saving and optimum level derived from the model. However, they conclude that the model does not explain how to make the exchange rate policy adjustments in order to reduce the gap.

With the fear of large fluctuations of hard currencies in medium-term, Borowski and Couharde (2003) tried to determine the macroeconomic balances between major countries vis-à-vis their exchange rates, since these fluctuations may cause world macroeconomic instability. They went further from the MB model in order to have panel exchange rate equilibrium in selected industrial countries, by applying the fundamental equilibrium exchange rate, using data until 1995, with the medium-projection up to 2000. They suggested adjustment of the Dollar, Yen and Euro, to be aligned with the fundamentals.

The reduced-form Equilibrium Real Exchange Rate (ERER) approach directly estimates an equilibrium real exchange rate for each country as a function of medium-term fundamentals such as the net foreign asset (NFA) position of the country, relative productivity differential between the tradable and non-tradable sectors, and the terms of trade (Cubeddu, 2018) .

As articulated by the Washington consensus, a country's exchange rate should remain competitive to continue supporting its exports and ultimately its growth while ensuring that it remains consistent with macroeconomic objectives in the medium term (Williamson, 2008; Dvornak et al., 2003). In light of this view, in a given country there exists an equilibrium real exchange rate (ERER) that satisfies its macroeconomic balance. Hence, any deviation of the RER from its equilibrium will hamper internal balance (economic growth) and sustainability of the external balance (current account) (Rodrik, 2008).

Other studies, however, have provided theoretical and empirical evidences that not all deviations from the ERER could negatively affect growth and exports. Indeed, Rodrik (2008) showed that while RER overvaluation harms growth and current account balance, the RER undervaluation improve them, mostly in developing countries.

Sekkat et al. (2011) found evidence supporting the view of Rodrik (2008) and showed that using a sample of 52 developing countries and utilizing the REER model, they deliberately choose the policy to keep their exchange rate undervalued in order to strengthen the price competitiveness in their manufacturing exports sector.

As mentioned above, Nuwagira and Muvunyi (2016)) studied the impact of the real exchange rate on the Rwandan external competitiveness, using the Behavioral Equilibrium Exchange Rate (BEER) method to determine the level of the real exchange rate misalignment and compute the Marshall-Lerner condition. The long-run BEER drew a relationship between the REER with the economic fundamentals, and the estimated coefficients highlighted that real exchange rate is influenced by economic fundamentals. Some of the factors play a role towards exchange rate under-valuation (for instance; the increase in government expenditure and the decrease of terms of trade) and other factors lead to the real exchange rate overvaluation (for instance; the increased in net foreign assets and the productivity gains). In addition, the study found that the Marshall-Lerner condition does not hold for Rwanda, since the sum of exports and imports elasticities are less than in absolute terms.

In addition, Nuwagira and Kigabo (2014)examined the

REER misalignment in Rwanda using quarterly data, spanning the period 2000Q1 to 2012Q4 using the ERER approach. The results from their study indicate the existence of the alternating episodes of overvaluation and undervaluation with the level of misalignment ranging between 0.04 percent and 2.3 percent.

The third strand of literature relates to the external sustainability (ES) approach. Muvunyi et al. (2019) used the ES methodology to evaluate the Rwandan Current Account Deficit vulnerability to the level of Net Foreign Assets, for the period 2010 to 2018 and considered 2019 – 2021 as medium-term projections period. The ES calculates the difference between the actual current account balance and the current balance that would stabilize the NFA position of the country at a desired benchmark level (Cubeddu, 2018) . The results show that the current account gap at the benchmark was higher, but it would be lower with the medium-term projections, suggesting a small depreciation in order to close the gap.

Lastly, Marola (2016) in his study conducted on a sample of 7 Latin American countries found that the rate of return on assets equals to liabilities, the ES adjustment is needed for trade, but when they differ, thus the adjustment must be on both trade and financial account. He Argued that the net international liabilities increase due to two sources, the income current account (primary income) and non-income current account (trade in goods and services and secondary income). Therefore, since the primary income is mostly composed of return on capital investment and interest payment of loan, based on the financial stocks, thus, the non-income current account is the one that could help to stabilize the financial stocks compared to the former.

In synthesis, the empirical literature on the real exchange rate misalignment remains mixed at best. Some studies suggest that real exchange rate deviations affect both the current account balance and economic growth. However, deviations of the real exchange rate from its equilibrium level affect the current account balance and economic growth in different ways. For instance, Rodrik (2008) indicates that while RER overvaluation harms growth and current account balance, the RER undervaluation improves them, especially in developing countries; thus, the desirable outcome is the one articulated by the Washington consensus that highlights the importance of the competitive real exchange rate to exports promotion and, ultimately economic growth, while ensuring that it remains consistent with macroeconomic objectives in the medium term. Moreover, there is paucity of empirical studies in the case of Rwanda. Most previous studies have largely relied on the reduced form equilibrium exchange rate model, especially the behavioral equilibrium exchange rate (BEER). In contrast to the previous studies which assessed external sector adjustment using one approach, this study brings together all the three approaches for better understanding of the issue and hence provides solid evidence on the implications of RER misalignment on economic activities. The use of three complementary methods as suggested by the IMF's CGER is a key contribution of this paper. In addition, assessing misalignment could have become more important in the most recent years as many economies' vulnerabilities rose due to the coronavirus pandemic and prolonged low international commodity prices, which weighed on the external sector performance.

3. Methodology

The methodological approach to conducting the external sector assessment follows the complementary approaches proposed by the IMF's CGER. The RER assessment is based on the equilibrium notion, particularly consistence in the internal and external balance over the medium to long term. The CGER analytical approaches include macroeconomic (MB) balance, equilibrium real exchange (ERER) model and the external sustainability approach (ES).

3.1. Macroeconomic Balance (MB Approach

Macroeconomic balance approach estimates the difference between the current account balance projected over the medium term at the ongoing exchange rates and the estimated current account norm. The MB approach is implemented 3 steps. Firstly, the estimation of the equilibrium relationship between the current account and a set of economic fundamentals.

Secondly, computing the current account norm from this relationship as a function of the level of fundamentals projected to prevail in the medium term. Thirdly, computing the real exchange rate adjustment that would restore the balance between the current account norm and the underlying current account. The macroeconomic balance is modeled from the intertemporal approach to current account, where the current account balance is an accounting identity linked to saving- investment gap. The identity reflects the intertemporal nature of the current account and the role of consumption smoothing (Sachs, 1981; Obstfeld and Rogoff, 1995) and (Obstfeld, 2004)). The model specification is a kin to Chinn and Prasad (2003), but customized to the country specifics and the general form of the model is specified as:

$$Ca_t = \alpha + \beta ca_{t-1} + \varphi x_t + \varepsilon_t \quad \text{.....(1)}$$

Where $ca_t$is the current value of the current account balance as a percentage of GDP, ca_{t-1} is the lagged value of the current account balance as a percentage of GDP, x_t is a vector of explanatory variables, including real GDP growth, fiscal balance, population, old age dependency,

government consumption, investment as a percentage of GDP and net foreign assets (NFA). α, β *and* $\varphi$are parameters to be estimated and ε_t is the error term. The variables used are draw for the previous studies, especially IMF's Methodology for CGER Exchange Rate Assessments.

3.1.1. Estimation Strategy

The current account determination model is estimated through single equation approach given that this paper assesses the exchange rate in a country specific context. We apply cointegration based estimators such as dynamic ordinary least squares (DOLS) [2]pioneered by Stock and Watson (1993) and further developed by Kao and Chiang (2000) and Mark and Sul (2003).

3.1.2. Definition of Variables and Data Sources

The variables included in equation 1, along with the indicators derived from the estimated relationship are constructed as follows:

Current account balance as a percentage of GDP is the sum of trade balance, services balance, primary income balance and secondary income balance divided by GDP, calculated as $Ca = \frac{tb+sb+pib+sib}{GDP}$

Lagged current account balance is a percentage of GDP $\left(\frac{ca}{GDP_{t-1}}\right)$. Government budget balance is calculated as the difference between government's revenue less expenditure, usually expressed as a percentage of GDP. Per capita GDP growth measures the growth GDP divided by population and is calculated as $ngdppc\_gr = ngdppc - ngdppc_{t-1} - 1$

. Population growth is measured as $pop\_gr = pop_{t-}pop_{t-1} - 1$. Government expenditure is the total government expenditure, including recurrent and capital spending of each individual countries divided by GDP. Old age dependency is defined as the ratio of population aged 65 and older to population aged 30 to 64 and data is obtained in 5 year frequency, requiring interpolation to obtain the missing data points. Oil balance.

Current account norm is constructed by multiplying each explanatory variable by its corresponding coefficient, then sum them up and the constant. The elasticity of current account balance to real exchange rate is given by:

Current account norm is constructed by multiplying each explanatory variable by its corresponding coefficient, then sum them up and the constant. The elasticity of current account balance to real exchange rate is given by:

$$\frac{\triangle ca}{y}\frac{\triangle rer}{rer} = -|\varepsilon_x|\frac{x}{y} + (1 - |\varepsilon_m|\frac{m}{y} .....(2)$$

where $\frac{\triangle ca}{y}\frac{\triangle rer}{rer}$ denotes the current account elasticity to real exchange rate, $|\varepsilon_x|$ is the export elasticity, y is GDP and therefore $\frac{x}{y}$ is export to GDP ratio, $|\varepsilon_m|$ is import elasticity and $\frac{m}{y}$ is import to GDP ratio.

Under MB approach, the exchange rate misalignment is defined as the difference between the underlying current account and the current account norm divided by the trade elasticities. $\left(\frac{reer_t - ereer_t}{ereer_t}\right) = \frac{uca_t - ca_t^{norm}}{\varepsilon_{x,m}}$.

The real exchange rate is the inflation adjusted and trade weighted nominal exchange rate[3], computed by multiplying the nominal effective exchange rate by the ratio of foreign price to domestic price, given by $reer_t = \sum_{t=1}^{k} neer_{it} * \frac{p^*}{p}$.

3.1.3. External Sustainability Approach

The external sustainability (ES) approach computes the difference between the actual current account balance and the balance that would stabilize the net foreign assets (NFA) position of a given country at some benchmark level. Computationally, this approach makes use of elasticities obtained from the macroeconomic balance approach, where the current account gap is translated into the RER adjustment that would bring the current account balance in consistency with its NFA stabilizing level over the medium term. While the complementary approaches are estimated by econometric models, ES approach does not rely on econometric estimations, but on a few assumptions relating to economy's potential growth rate and inflation rate. Given its simple structure, the ES acts as a benchmark against which to compare the results from the above econometric approaches.

The link between the current account norm and the NFA position is obtained by imposing the steady state conditions on balance of payment identity. The point of departure is a simple balance of payments identity expressed as the sum of current account balance, capital account balance, and financial account balance, including reserves plus net errors and omissions, which is by construction zero. The identity is specified as:

$$CA_t + KA_t + FA_t + E_t = 0.....(3)$$

Let's assume that capital gains accruing from valuation changes is given by

$$KG_t = KG_{At} - KG_{lt}.....(4)$$

[2] The choice of the estimation methodology is informed by the fact that DOLS deals with small sample issues and possible endogeneity by allowing lags and leads in the estimation procedure.

[3] Nominal exchange rate is defined as the price a country's currency in terms of other currencies.

Where KG_{At} andKG_{lt} are capital gains on assets and liabilities, respectively. Substituting equation 4 into the Balance of payments identity yields.

$$NFA_t - NFA_{t-1} = CA_t + K_t + KG_t + E_t.....(5)$$

Dividing through equation 5 by nominal GDP yields.

$$ca_t + k_t + kg_t + e_t = NFA_t - \frac{NFA_{t-1}}{GDP}\frac{GDP_{t-1}}{GDP_t} \\ = nfa_t - nfa_{t-1} + \frac{g_t}{1+g_t}nfa.....(6)$$

Where the lower case letters are ratios to GDP and g_t is the nominal GDP growth. For simplicity, we assume no capital transfers ($k_t = 0$) , no capital gains ($kg_t = 0$) and no errors and omissions ($e_t = 0$) , thus the current account balance and the nominal GDP growth are generally the key drivers of the $\frac{nfa}{GDP}$.

The current account norm that would be consistent with the steady state level of NFA is thus given by.

$$ca_t^s = \frac{g_t}{(1+g_t)}nfa_t^s.....(7)$$

If we decompose the nominal GDP growth into real growth and inflation using GDP deflator by π_t we obtain.

$$ca_t^s = \frac{g_t + \pi_t}{1 + g_t + \pi_t}nfa^s.....(8)$$

3.1.4. Definition of Variables and Data Sources

The series in equation (8) are constructed as follows. Net foreign assets is calculated as difference between assets and liabilities $nfa = total\ assets - total\ liabilities$, this definition follows (Lane and Milesi-Ferretti, 2007) . Nominal GDP in U.S. dollars is the nominal gross domestic product in USD. Real GDP growth rate in (LCU), defined as Real GDP Annual Change, in LCU (in percent) and given by $rgdppc_gr = rgdppc - rgdppc_{t-1} - 1$Real effective exchange rate given by. $reer_t = \sum_{t-1}^{k} neer_{it} * \frac{p^*}{p}$. Inflation rate is the change in the consumer price index (percentage) calculated as $inf = \left(\frac{cpi_t - cpi_{t-1}}{cpi_{t-1}}\right) * 100$. Current account balance in USD is the sum of trade balance, services balance, primary income balance and secondary income balance, calculated as $ca = tb + sb + pib + sib$ .While current account as a share of GDP is given by $ca = \frac{tb+sb+pib+sib}{gdp}$

3.1.5. Equilibrium Real Exchange Rate Approach

The reduced form equilibrium exchange rate approach estimates the equilibrium real exchange rate (ERER) and computes the deviation of actual exchange rate from its equilibrium value. Its empirical assessment presents a challenge in a sense that the equilibrium real exchange rate is unobservable. The starting point to addressing this is to define the concepts of real exchange rate and equilibrium real exchange rate. The RER is domestic relative price of traded to non-traded goods, expressed as $reer_t = E * \frac{p_t^*}{p_n}$ Where E is the nominal exchange rate, p_t and p_n are prices of tradables and non tradables, respectively. The ERER is defined by (Nurkse, 1945) as the value of RER that induces both the internal and external equilibrium, given sustainable values of relevant variables achieving this objective. The deviation from the equilibrium RER is known as real exchange rate misalignment. To estimate ERER and obtain measures of real exchange rate misalignment, we follow behavioral equilibrium exchange rate approach by Clark and Macdonald (1998). The BEER approach computes equilibrium exchange rate as a function economic fundamentals. In this paper use fundamentals that are similar to Berg and Miao (2010) and Macdonald and Vieira (2010) . Our empirical model is thus specified as:

$$reer_t = \alpha + \alpha_1 tot_t + \alpha_2 open_t + \alpha_3 nfa_t \\ + \alpha_4 prod_t + \alpha_5 gov_t + \varepsilon_t.....(9)$$

Where$t = 1.....,T$ denote time period, $reer_t$ is the real effective exchange rate, tot_t are the terms of trade,$open_t$ is the degree of trade openness, nfa_t is net foreign assets, $prod_t$ is productivity proxied by real per capita gross domestic product, gov_t is government consumption as percentage of GDP$\alpha = (1, ..., 5)$ are parameters to be estimated and ε_t is the error term.

3.1.6. Estimation strategy

To estimate the relationship specified in equation (2), we apply single equation dynamic ordinary least squares estimator (DOLS) developed by Stock and Watson (1993) and further developed by Kao and Chiang (2000) and Mark and Sul (2003).

This approach improves OLS by circumventing the problem of small sample bias and dynamic sources of bias owing to the fact that it corrects for endogeneity by adding leads and lags. Indeed, Kao and Chiang (2000) argue that DOLS performs better in small samples, a result that is confirmed by Rahman (2017) using Monte Carlo simulations.

This estimation technique is used, along with complementary estimators such as fully modified ordinary least squares (FMOLS) and canonical cointegration regression (CCR). After estimating the ERER model, we derive sustainable values of economic fundamentals by decomposing RER into their permanent and cyclical components, implemented via (Hodrick and Prescott, 1997) HP filter and finally compute the misalignment indicator given by $Mis_t = reer_t - ereer_t$ where $ereer_t$is the equilibrium real exchange rate and where positive (negative) values of Mis_t indicate overvaluation (undervaluation).

3.1.7. Definition Variables and Data Sources

The series in equation (3) are constructed as follows. The real exchange rate is the inflation adjusted and trade weighted nominal exchange rate, computed by multiplying the nominal effective exchange rate by the ratio of foreign price to domestic price, given by $reer_t = \sum_{t=1}^{k} neer_{it} * \frac{p^*}{p}$. The real exchange rate misalignment indicator is the exchange rate deviation from the equilibrium level based on Hodrick-Prescott (HP) filter, constructed as $Mis_t = reer_t - ereer_t$. Net foreign assets is calculated as difference between assets and liabilities $nfa = total\ assets - total\ liabilities$, this definition follows Lane and Milesi-Ferretti (2007). Relative productivity proxied by real per capita GDP is calculated as nominal GDP divided by the population and its growth rate is given by $ngdppc_gr = ngdppc - ngdppc_{t-1} - 1$Government expenditure is the total government expenditure, including recurrent and capital spending divided by GDP. Openness is measured as the sum of exports and imports divided by GDP, calculated as $open = \frac{x+m}{gdp}$. All the series are expressed in natural logs and nominal GDP is measured in US dollars. We use quarterly data, covering the period 2000Q1-2020Q4 and data is sourced from IMF's world economic outlook database (WEO) and National Bank of Rwanda database.

4. Estimation Results

4.1. Results of Macroeconomic Balance Model

This sections reports the results from the three complementary models used in the assessment of external sector sustainability. We first present the results of the macroeconomic balance model. Under this model, the coefficient of the lagged current account is positive and statistically significant, suggesting the presence of adjustment process in the current account. The coefficient of population growth turns out be negative and statistically significant, implying that higher population decreases savings, thus the current account. This result is line with Higgins (1998). Fiscal balance emerges positive and statistically significant, this is due to the fact a higher government budget balance increases national savings and thereby increasing the current account balance, a result that is consistent with Ahmed (1986) and Chinn (2005) . The coefficient of output growth is negative and significant, indicating that economies that are lower stages of development such as Rwanda import more than they export, leading to a reduction in the current account balance. The coefficient of oil balance is negative and statistically significant, implying that higher oil prices deteriorates the current account balance for the net importers of oil like Rwanda. Generally, our results indicate that Rwanda's current account balance is in line with the economic fundamentals. Building on the estimated results of the current account determination model, we proceed with the estimation of both the underlying current account norm. For the underlying current account, we take the unadjusted current account balance as a percentage of GDP, taking 2020 as the benchmark year. This is because the cyclical factors such as the output gap turned out insignificant.

The current account norm is calculated by multiplying projected medium term value of each explanatory variable by their respective coefficient estimates. In computing the norms, medium-term values of the current account balance, fiscal balance, population growth, oil balance, output growth, are sourced from the World Economic Outlook (WEO) database.

We also estimated trade elasticity, obtained by estimating the individual export and import demand functions. From these two functions, the estimated semi-elasticities with respect to exchange rate are used to compute the total trade elasticity as follows.

$$\varepsilon_{x,m} = (-0.32) * (0.21) + (0.41 - 1) * (0.34) = -0.27$$

Given the underlying current account (-12.2), current account norm (-8.02), which gives a current account gap of -4.18 and the trade elasticity (-0.27), the real exchange rate gap under macroeconomic balance is computed as.

$$\frac{uca - ca^{norm}}{\varepsilon_{x,m}} = \frac{(-12.1 - (-8.02))}{-0.27} = 15.1$$

This result indicate 15.1 percent overvaluation, which implies that the Rwandan currency should depreciate in real terms by 15.1 percent to close the gap between the underlying current account and the current account norm.

4.2. Results of External Sustainability

This subsection reports the results of external sustainability approach. Under this approach, the computations are not based econometric estimation, but rather on the assumptions about the potential growth rate of the economy. The data requirements for the external sustainability include the construction of the current account balance that would stabilize Rwanda's NFA/GDP at benchmark level, here we consider the last data point for which complete data is available, thus we use net international investment position (NIIP) for the year 2020 as the benchmark level of NFA/GDP. Secondly, we use 5 year average medium term growth in nominal GDP, which is 7.03 percent and the National Bank of Rwanda's medium term inflation target of 5 percent. Based on this information, we compute the NFA stabilizing current account as follows.

$$ca^s = \frac{g + \pi}{1 + g + \pi} nfa^{benc} = \frac{0.07 + 0.05}{1.o7 + 0.05} * (-68) = -7.3$$

Table 2: Macroeconomic Balance Estimation Results

Dependent variable: CA/GDP				
Variables	**Coefficient**	**Standard Err**	**T-Stat**	**P-Value**
Lagged CA/GDP	0.080	0.055	14.47	0.000
Population growth	-0. 174	0.097	-1.79	0.077
Fiscal balance	0.043	0.021	2.03	0.046
Output growth	-0.377	0 .212	-1.78	0.080
Oil balance	-0.312	0.146	-2.13	0.036
Old age dependency	0.162	0.398	0.41	0.684
Constant	1.881	2.077	0.91	0.368

Given the NFA stabilizing current account balance, the underlying current account and the trade elasticity obtained under the macroeconomic balance model, the exchange rate gap under external sustainability approach is calculated as the difference between the underlying current account and the NFA stabilizing current account at a benchmark level of NFA.

$$ES = \frac{uca - ca^s}{\varepsilon_{x,m}} = \frac{(-12.2 - (-7.3))}{-0.27} = 17.7$$

This result indicates that the exchange rate is overvalued by 17.7 percent and points to the level of exchange rate adjustment that is needed to restore the balance between the underlying current account and the balance that stabilizes the NFA/GDP at some benchmark level, thus Rwandan currency should depreciate by 17.7 percent for the underlying current account to improve -12.1 percent of GDP to the NFA stabilizing level of -7.3 percent of GDP.

4.3. Results of Behavioral Exchange Rate Model

Table 2 reports the results of the reduced form model based on single equation cointegration estimators such as DOLS, FMOLS and CCR, with a particular emphasis on DOLS. We estimated the long-run relationship between REER and a set of economic fundamentals. The parameter estimates are presented in columns (2) -(4). All variables included in our empirical set up are statistically significant, with expected signs, implying that the real exchange rate is in line with economic fundamentals. The coefficient of openness is positive and statistically significant due to trade restrictions in terms of higher tariffs, resulting in high demand for non-traded goods and leading to higher domestic prices that induce real exchange rate appreciation. The positive and statistically significant coefficient of terms of trade indicate that the income effect dominates, meaning that improvement in terms of trade raises demand for locally produced goods (non-traded) hence non-traded goods prices increase relative to traded goods, thus appreciating Rwanda's currency.

Government expenditure turns out to be positive and statistically significant, this is because higher government expenditure translates into higher demand for non-traded goods inducing the rise in prices of non-traded goods leading to the real appreciation of real effective exchange rate[4]. The coefficient of productivity is positive and statistically significant, suggesting that productivity improvement relative to trading partners generates real exchange rate appreciation, a phenomenon well known in literature as "Balassa- Samuelson effect".

Finally, the coefficient of NFA is positive and statistically significant, which implies that that increase in long-run capital inflows appreciate real exchange rate. Indeed, over the recent past, Rwanda has received enormous amounts of capital flows and can therefore afford a more appreciated REER, while retaining the ability to restore the external balance through financing the associated current account deficits.

Source: Authors' Estimations

4.4. Exchange Rate Misalignment

The estimated results of the equilibrium exchange rate model, along with the Hodrick and Prescott (1997) HP filter are used to obtain sustainable values of economic fundamentals, whereby HP filter decomposes REER into their permanent and cyclical components and thus the level of misalignment is computed as the difference between the actual real effective exchange rate and the equilibrium real effective exchange rate, which is the permanent component. Figure 1 below depicts the level of misalignment over the entire sample period.

From the figure, we identify alternating episodes of overvaluation and undervaluation. While overvaluation and undervaluation are not desirable for the attainment of long-run REER stability, the level of misalignment is not persistent and not very high. Taking the last five years, corresponding to 20 quarters, Rwanda's real effective exchange rate is overvalued by 7.6 percent, suggesting that Rwandan franc should depreciate by 7.6 percent in real effective terms to bring back the REER to its sustainable levels. Generally, this level of misalignment is not too high and the associated episodes are not persistent to induce a

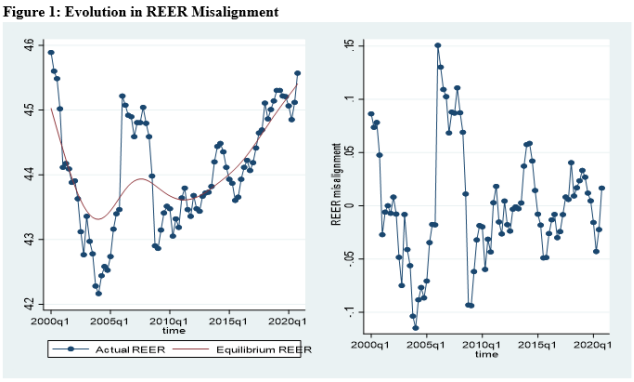
[4] Due to differences in tastes and preferences, increased government may lead to expenditure switching whereby higher government spending may translate into higher imports thereby depreciating exchange rate.

Table 3: BEER Estimation Results

	(1)	(2)	(3)
VARIABLES	**DOLS**	**FMOLS**	**CCR**
Openness	0.029***	0.031***	0.031***
	(0.007)	(0.009)	(0.008)
Terms of trade	0.244***	0.127*	0.126*
	(0.059)	(0.071)	(0.076)
Government expenditure	0.539***	0.425***	0.430***
	(0.078)	(0.104)	(0.110)
Productivity	0.000***	0.000**	0.000*
	(0.000)	(0.000)	(0.000)
Net foreign assets	0.006*	-0.000	0.000
	(0.004)	(0.002)	(0.003)
Constant	1.775***	2.633***	2.621***
	(0.355)	(0.442)	(0.456)
Observations	72	74	74
R-squared	0.727	0.201	0.141

negative effect on external sector competitiveness.

Figure 1: Evolution in REER Misalignment



Source: Authors' Estimations

5. Conclusion

The main objective of this paper was to re-assess the exchange rate and external sector competitiveness in Rwanda using three complementary approaches, the macroeconomic balance, the external sustainability and the reduced form ERER proposed by IMF's Consultative group on Exchange rate issues to measure the consistency of the current account balance and real effective exchange rate with their underlying economic fundamentals. We use quarterly data, spanning the period 2000Q1-2020Q4. With regard to the estimation techniques, we use OLS for the current account determination model and the estimation of trade elasticities and for the behavior equilibrium exchange rate model, we apply single equation cointegration techniques, especially DOLS and its alternative specifications such as FMOLS and CCR, which are used as robustness checks.

The results indicate that both the current account and the real effective exchange rate are influenced by their underlying economic fundamentals. The estimated exchange rate misalignment levels from the three approaches point to the same direction and are broadly in line with IMF external sector assessment for Rwanda that was conducted in 2019, which obtained the exchange rate gap (overvaluation) of 19.4 percent.

The current research obtains an average exchange rate gap for the three models of 13.4 percent, implying that Rwandan currency is overvalued in real effective terms by 13.4 percent, which has ripple effect on the external sector position, particularly export competitiveness. As such, the exchange rate adjustment required to bring the current account and the REER to their sustainable levels is to depreciate Rwandan currency by 13.4 percent in the medium term. However, external sector competitiveness is still strong, but there is still potential to improve.

The important policy implications that arise out of these empirical findings include maintaining moderate exchange rate flexibility to cushion adverse external shocks, but also effective monitoring of exchange rate developments remains vital to avoid higher levels of volatility which could lead to poor performance of the country's tradable sector. Implementing fiscal consolidation and structural reforms to further improve the business climate and boost competitiveness that would bring the current account balance to its sustainable levels. Strengthen strategies to facilitate diversification of the country's export base to improve the current account balance.

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