

A New Currency for the East African Community?

Support from a Time Series Study

Hector Carcel

University of Navarra Faculty of Economics and NCID, Spain

Abstract

In this study we make use of novel time series techniques to support the Generalized Purchasing Power Parity (G-PPP) and the Optimal Currency Area (OCA) theory in the East African Community (EAC). We provide reasons for the feasibility of a new common currency in the region and we explain why new techniques such as fractional cointegration can be a useful tool for policy makers studying macroeconomic variables. We find evidence supporting convergence between the exchange rates of the EAC countries, and we discuss other macroeconomic features that are of relevance for the region. Policy implications and recommendations are also discussed.

Keywords: East African Community; OCA; G-PPP; Exchange Rate; Fractional Cointegration.

JEL Classification: C32, F31, F45.

1 Introduction

In late 2013 the East African Community (EAC) countries Burundi, Kenya, Rwanda, Tanzania, and Uganda signed a joint protocol setting out the process and convergence criteria for an EAC monetary union. The signing of the protocol constitutes a further step toward regional economic integration in the region, following the ratification of the protocols for a customs union and a common market. Proposed for 2024 is the introduction of a common currency to substitute the national currencies of member countries. The question of whether the EAC constitutes an Optimal Currency Area (OCA) is hence discussed in this paper, providing new evidence based on novel time series techniques in favor of the establishment of a new common currency for the region.

A monetary union can have relevant benefits for the member countries of the EAC. According to Rose (2004), by eliminating currency conversion costs and exchange rate risks between the member countries, a single currency can promote intra-regional trade. It is also possible that the supranational monetary authority could obtain a greater credibility for setting prudent monetary policy compared to the central banks of the individual countries, as explained by Guillaume and Stasavage (2000). Expectations of financial stability contribute to financial deepening, greater investment, and faster economic growth. Such institutional credibility gains are particularly important in developing countries with relatively short history of independent policy making, as it is the case of the EAC countries. According to the OCA literature, these countries will benefit from closer integration, with gains from lower transaction costs, price stabilization, more efficient resource allocation, improved access to goods, labor, and financial markets, stimulating thus trade, investment and economic growth. The costs associated with this change will be reflected by the size, nature, and frequency of asymmetric shocks as well as the ability of countries to adjust to such shocks with respect to the EAC area through certain channels, such

as fiscal policy, labor mobility, and wage and price flexibility.

In this work we provide support for the establishment of a common currency in the East African Community (EAC). We do so by testing whether the Generalized Purchasing Power Parity (G-PPP) holds in the EAC by means of fractional cointegration. Classical cointegration models used in most OCA studies imply short memory residuals as equilibrium errors in the cointegrating relationships. This issue distorts the cointegrating results given that most macroeconomic series, such as exchange rates, possess long memory. This fact needs to be captured in order to be as accurate as possible in determining whether a group of countries constitutes an OCA. If we do not consider the long memory aspect of macroeconomic series such as exchange rates we can obtain misleading cointegrating results and consequent wrong conclusions. This is why we have decided to carry out an analysis using fractional integration and cointegration techniques in order to obtain results capturing this long memory nature of the exchange rates. Given that South Sudan joined the EAC recently in April 2016 and data availability from this country is scarce at the moment, we decided to focus our study on the remaining five countries of the EAC.

Recent studies employing fractional integration and cointegration on other country unions, such as the work carried out by De Truchis and Kedadd (2014) on ASEAN economies, come to show the relevance of implementing these techniques in country unions. In addition to this, we believe it is important to analyze the cointegrating relationships between the exchange rates of the EAC countries given the fact that recently in August 2016 the EAC decided to phase out the dollar as the cross-border trade currency within the region. With business and economic transactions soon being performed with local currencies, knowing the possible effects of external shocks in the different exchange rates turns out to be of great relevance. In order to complement our study on fractional cointegration relationships between the exchange rates of the EAC countries, we also provide results on business cycle convergence

within the region. The results reveal positive convergence signs between the member countries, supporting thus this union of eastern African countries and specially the formation of a common monetary union. Evidence from the European Monetary Union can nevertheless easily alert policy makers about the dangers that forming a currency union can cause in the EAC.

The remaining structure of the paper is as follows: in section 2 we provide an introduction to the Optimal Currency Area and the Generalized Purchasing Power Parity. In section 3 we give grounds to consider the EAC as an OCA by explaining its history. In section 4 provide a concise literature review on previous studies. In section 5 we explain the fractional integration and cointegration techniques that have been employed. In section 6 we provide the results with some policy recommendations and finally section 7 concludes the paper.

2 The Generalized Purchasing Power Parity and the Optimal Currency Area

The Generalized Purchasing Power Parity (G-PPP) states that for m countries in a world of n countries there exists a long-run equilibrium relationship between the $m-1$ bilateral real rates such that these bilateral real exchange rates in a given period constitute the parameters of the corresponding cointegrating vectors. When G-PPP holds, the real exchange rate between two countries can be expressed as a weighted average of the other real exchange rates in the currency area. These weights do not only reflect trade linkages, but also broader linkages such as technology transfers, immigration and financial resource movements. It is of interest to know the type of exchange rate regime of the currencies on which we want to study the G-PPP. The three biggest countries in the EAC present managed floats, with fully open capital

accounts in Kenya and Uganda, and a liberalization that will soon remove capital account restrictions in Tanzania. Burundi and Rwanda seem to be on their way to achieve a similar regime.

The G-PPP can be interpreted in terms of an Optimum Currency Area (OCA). When fulfilled for a group of regions or countries, the corresponding member economies would most likely be linked by trade in goods and services and also by factor mobility. Such group of countries could therefore be considered as an ideal regional zone, having a single common currency or group of currencies which are pegged to each other and have unrestricted substitutability for all supply side transactions within the zone, while moving together against the rest of the currencies in the world. According to Mundell (1961), assuming rigid prices and wages in the short run without factor mobility, regions or nations can constitute the domain of an optimal currency area if they experience the same type of real disturbances. Besides factor mobility, the volume of intra-regional trade among members is also important.

As suggested by global evidence, entering a monetary union tends to reduce endogenously some forms of macroeconomic asymmetry across countries, as explained by De Grauwe (2009). For the case of the EAC it could be that while such asymmetries may persist, the transition towards a monetary union could be an opportunity to reduce the exposure of its member countries to such asymmetric shocks. Based on the Heckscher-Ohlin model, if two countries are major trading partners then some degree of factor price equalization may take place. Thus, in a setting of more than two countries within a well defined currency area, the fundamental variables should be sufficiently interrelated, so that the real exchange rates themselves will share a common stochastic trend. Hence, according to Enders and Hurn (1994), within a currency area there should be at least one cointegrating combination of the various bilateral real exchange rates.

3 History of the East African Community

In order to determine whether the East African Community constitutes an OCA we need to understand its history, which is long and characterized by both failures and successes. The EAC is an intergovernmental organization constituted by the recently established nation of South Sudan and the five countries in the African Great Lakes region in eastern Africa: Burundi, Kenya, Rwanda, Tanzania and Uganda. The institution was originally established in 1967, disappeared in 1977 and was officially revived again on 7 July 2000. In 2008, as a result of negotiations with the Southern African Development Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA), the EAC accepted to be part of a free trade area that includes the member states of the three organizations, thus becoming an integral part of the African Community. The East African Community is also a potential precursor to the establishment of an East African Federation.

Kenya, Tanzania and Uganda have had a history of cooperation already since the early 20th century. The customs union between Kenya and Uganda in 1917 was later joined by the then Tanganyika in 1927. Inter-territorial cooperation between the Kenyan Colony, the Ugandan Protectorate and the Tanganyikan Territory was formed in 1948 by the constituency of the East African High Commission. The creation of this institution led to the first customs union and a common external tariff. It also dealt with common services in communications, transport, research and education. After obtaining independence from Britain, these integrated activities were reconstituted and the High Commission was replaced in 1961 by the East African Common Services Organization. Many observers at the time considered that this would lead to a political federation between the three territories. In 1967 the East African Common Services Organization was replaced by the East African Community. This institution aimed to strengthen ties between members through a common market, a common customs tariff and a range of public services in order to achieve balanced

economic growth within the region. The new organization however faced difficulties due to the lack of joint planning and fiscal policy, separate political policies and the dominant economic position of Kenya. The EAC was therefore officially dismantled in 1977.

Kenya, Tanzania and Uganda signed the Treaty for the re-establishment of the East African Community (EAC) in 1999, which entered into force in July 2000. In 2007 the Treaty was signed by Burundi and Rwanda, expanding the EAC to five countries. According to the Treaty, the EAC should first form a customs union, then a common market and a monetary union. In 2010 the EAC initiated its own common market for capital, goods and labor in the region, with the objective of establishing a common currency union and eventually a full political federation. The work of forming a monetary union started early, but has progressed slowly. Thus, in 2007 the EAC member countries decided to accelerate its establishment. The intention was to sign a protocol to establish the East African Monetary Union (EAMU) in 2012, which was finally signed in 2013, while actual implementation, though it was planned to be completed by 2015, it is now expected to take several years, not before 2024. Recently in April 2016 South Sudan joined the EAC, in a clear sign of collaboration from the EAC to integrate the newly established country in the region.

4 Previous studies and the case of the EAC

All the works that have been done studying the establishment of a new currency for the EAC in the cointegration framework have been carried out based on the more traditional $I(0)/I(1)$ domain, generally stating against the formation of a currency union in the region. Considering the limitations induced by traditional cointegration, in this work we will consider that shocks on the EAC countries Real Exchange Rates (RER) can be persistent, meaning that long memory in the residuals of the

cointegrating relationship exists and therefore a slow return towards the long-run equilibrium can take place. A fractional cointegration analysis allows us to capture these relationships by considering that such residuals can follow a fractional process $I(d)$. A large number of papers have dealt with the theory of Purchasing Power Parity (PPP) in the long memory framework, representing an important subject in monetary models of exchange rate determination. Among some of the most relevant works in the literature, Booth, Kaen and Koveos (1982) found positive memory during the flexible exchange rate period (1973-1979). Later, Cheung (1993) gave evidence of long memory behavior in foreign exchange markets during the managed floating regime. Baum, Barkoulas and Caglayan (1999) provided fractional integration models for real exchange rates in the post-Bretton Woods era. A thorough description of these works and their technicalities can be found in Gil-Alana and Hualde (2009).

The first works applying the concept of fractional cointegration were in fact devoted to analyzing the Purchasing Power Parity (PPP), referring to the tendency of nominal exchange rates and prices to adjust in such a way that the real exchange rate tends to revert to its parity value. The literature has mainly provided evidence of weak fractional cointegration with nonstationary but meanreverting cointegrating errors, as presented by Diebold, Husted and Rush (1991). Taking into account that the nominal exchange rates were non-stationary, Baillie and Bollerslev (1994) reported evidence of fractional cointegration between several European exchange rates. These works emphasize the relevance of implementing fractional integration and cointegration techniques in the study of the G-PPP, which serves as basis for the constitution of an OCA. In this work we carry out for the first time such type of study on the exchange rates of the EAC employing, among other techniques, the recently introduced FCVAR model by Johansen and Nielsen (2012).

Several papers have been published with the purpose of analyzing the feasibility

of the East African Community. Studying the OCA theory, Mafusire and Brixiova (2013) tested empirically the extent of the shock synchronization among the EAC members, concluding that if the countries in the union have major structural differences as they currently do, a common monetary policy would have differential impacts that may not be helpful to some members. A few authors have studied the viability of a monetary union in the EAC, having used different models and reached different conclusions. Buigut and Valev (2005) applied a two-variable SVAR model to test for shock correlation in the EAC countries, concluding that a monetary union in the EAC is not feasible. Yabara (2014) investigated the dynamics of the currency markets in the East African Community, showing that the exchange rates of Kenya, Tanzania and Uganda have been mainly driven by shocks to their own economies, while those of Burundi and Rwanda have been increasingly dictated by spillovers from the dollar and the euro since the global financial crisis. In this work we contribute to the current literature on the EAC by providing an analysis of its exchange rates based on fractional integration and cointegration techniques. We provide hence evidence based on novel time series techniques that support the establishment of a common currency in the EAC.

5 Methodology

5.1 Long Memory and Fractional Integration

A main characteristic of many economic and financial time series is its nonstationary nature. Until the 1980s a standard approach to study time series was to impose a deterministic function of time, thus assuming that the residuals from the regression model were stationary. After the seminal work by Nelson and Plosser (1982), there was a general agreement that the nonstationary element of most series was stochastic,

and unit roots, or $I(1)$ processes, were commonly adopted. This case is however just one particular model to describe such behavior, since the number of differences required to obtain stationarity may not necessarily be an integer value but any point in the real line. In such case the process is said to be fractionally integrated or $I(d)$, with such models belonging to a wider class of processes known as long memory.

Long memory implies that observations which are far apart in time are highly correlated. A traditional way of capturing the long memory of a given series is precisely by the use of fractional integration. A fractionally integrated, or $I(d)$ model, x_t , can be expressed in the following form:

$$(1 - L)^d x_t = u_t, \quad t = 0, \pm 1, \dots, \quad (1)$$

where d can be any real value, L is the lag-operator ($Lx_t = x_{t-1}$) and u_t is $I(0)$, defined as a covariance stationary process with a spectral density function that is positive and finite at the zero frequency. The polynomial in equation (1) can be expressed in terms of its binomial expansion, such that, for all real d ,

$$(1 - L)^d = \sum_{j=0}^{\infty} \binom{d}{j} (-1)^j L^j = 1 - dL + \frac{d(d-1)}{2!} L^2 - \frac{d(d-1)(d-2)}{3!} L^3 + \dots$$

and thus

$$(1 - L)^d x_t = x_t - dx_{t-1} + \frac{d(d-1)}{2!} x_{t-2} - \frac{d(d-1)(d-2)}{3!} x_{t-3} + \dots$$

In this context, d plays a crucial role since it indicates the degree of dependence of the time series. The higher the value of d is, the higher the level of association between the observations. We can distinguish several situations depending on the

value of d . Thus, if $d = 0$, $x_t = u_t$, x_t is said to be short memory or $I(0)$, and if the observations are autocorrelated (i.e. AR), then they are of a weakly form, in the sense that the values in the autocorrelations will decay exponentially. If $d > 0$, x_t is said to be long memory, so named because of the strong association between observations that are distant in time. Here, if d belongs to the interval $(0, 0.5)$ then x_t is still covariance stationary, while $d \geq 0.5$ implies nonstationarity. Finally, if $d < 1$, the series is mean reverting implying that the effects of external shocks will eventually disappear in the long run, contrary to what may happen if $d > 1$, with shocks persisting indefinitely. There are several methods for estimating and testing the fractional differencing parameter d of a series. Some of them are parametric while other are semiparametric and can be specified in the time or in the frequency domain. In this work we use a Whittle estimate of d in the frequency domain (Dahlhaus, 1989) along with a testing procedure based on the Lagrange Multiplier (LM) principle that also uses the Whittle function in the frequency domain. We test the null hypothesis:

$$H_0 : d = d_0, \tag{2}$$

for any real value d_0 , in a model given by the equation (1), where x_t can be the errors in a regression model of the form:

$$y_t = \beta^T z_t + x_t, \quad t = 1, 2, \dots \tag{3}$$

where y_t is the observed time series, β is a $(k \times 1)$ vector of unknown coefficients and z_t is a set of deterministic terms that might include an intercept (i.e., $z_t = 1$), an intercept with a linear time trend ($z_t = (1, t)^T$), or any other type of deterministic processes. The LM test used can be found in Robinson (1994). This estimator is robust to a certain degree of conditional heteroscedasticity and is more efficient than other more recent semiparametric competitors.

5.2 Fractional Cointegration

The multivariate extension of the $I(d)$ model is captured by the concept of fractional cointegration, which is used to determine the long-run equilibrium relationship between series. Given two real numbers d, b , the components of the vector z_t are said to be cointegrated of order d, b , denoted $z_t \sim CI(d, b)$, if all the components of z_t are $I(d)$ and there exists a vector $\alpha \neq 0$ such that $s_t = \alpha' z_t \sim I(\lambda) = I(d - b), b > 0$. Here, α and s_t are called the cointegrating vector and error respectively. In this work we decided to carry out tests for bivariate cointegration based on Marinucci and Robinson (2001) in order to determine the possible vis-à-vis cointegrating relationships between the exchange rates under study. A recently introduced method to check for multivariate fractional cointegration is the Fractionally Cointegrated Vector AutoRegressive (FCVAR) model introduced by Johansen (2008) and further expanded by Johansen and Nielsen (2010, 2012). The model is a generalization of Johansen (1996) Cointegrated Vector AutoRegressive (CVAR) model which allows for fractional processes of order d that cointegrate to order $d - b$. In order to introduce the FCVAR model we can refer first to the well-known, non-fractional, CVAR model. Let $Y_t, t = 1, \dots, T$ be a p -dimensional $I(1)$ time series. The CVAR model is:

$$\Delta Y_t = \alpha \beta' Y_{t-1} + \sum_{i=1}^k \Gamma_i \Delta Y_{t-i} + \varepsilon_t = \alpha \beta' L Y_t + \sum_{i=1}^k \Gamma_i \Delta L^i Y_t + \varepsilon_t. \quad (4)$$

The simplest way to derive the FCVAR model is to replace the difference and lag operators Δ and L in (4) by their fractional counterparts, Δ^b and $L_b = 1 - \Delta^b$, respectively. We then obtain

$$\Delta^b Y_t = \alpha \beta' L_b Y_t + \sum_{i=1}^k \Gamma_i \Delta^b L_b^i Y_t + \varepsilon_t, \quad (5)$$

which is applied to $Y_t = \Delta^{d-b} X_t$ such that

$$\Delta^b X_t = \alpha \beta' L_b \Delta^{d-b} X_t + \sum_{i=1}^k \Gamma_i \Delta^b L_b^i Y_t + \varepsilon_t, \quad (6)$$

where ε_t is p -dimensional independent and identically distributed with mean zero and covariance matrix Ω . The parameters have the usual interpretations known from the CVAR model. In particular, α and β are $p \times r$ matrices, where $0 \leq r \leq p$. The columns of β are the cointegrating relationships in the system, that is to say the long-run equilibria. The parameters Γ_i govern the short-run behavior of the variables and the coefficients in α represent the speed of adjustment towards equilibrium for each of the variables. Thus, the FCVAR model permits simultaneous modelling of the long-run equilibria, the adjustment responses to deviations from the equilibria and the short-run dynamics of the system. In Johansen and Nielsen (2012) and Nielsen and Morin (2016) one can find estimation and inference explanations of the model, and the latter provides Matlab computer programs for the calculation of estimators and test statistics.

6 Results and Policy Implications

We employed monthly data ranging from 1990 up to 2015 obtained from International Financial Statistics. A graphical representation of the corresponding real exchange rate to the US dollar series is shown in figure 1. All of the five series present an increasing pattern, and from a graphical inspection it seems they present similar characteristics. We conducted standard unit root tests of the five exchange rates finding out that none of the series presented stationarity. We therefore decided to carry out a fractional integration analysis of the series under study.

We obtained the d values corresponding to the degree of fractional differentiation

of the series using the parametric approach explained earlier, as shown in table 1. In no case could the unit root be rejected, implying thus that the series are quite persistent and prone to persistency when affected by shocks. According to these results, all the five exchange rates will in principle be influenced in the same degrees when affected by an external shock. We checked whether bivariate cointegrating relationships exist between the five exchange rates and the results are presented in table 2. We found that in 6 out of the possible 10 bivariate relationships the existence of fractional cointegration cannot be rejected, which gives considerable signs of homogeneity within the region. The exchange rate of Tanzania fractionally cointegrates with all the other exchange rates, while the exchange rate of Rwanda is fractionally cointegrated with the one of Burundi and Uganda. These results come to tell that shocks affecting the Tanzanian Shilling will have a clear effect on all the other currencies, and therefore maintaining such currency stable shall be a goal for policy makers in the region. The same cannot be said about the exchange rate of the Kenyan Shilling, which does not seem to have such a big effect on the neighboring currencies. These facts, although not entirely fulfilling the requirements of the G-PPP, can nevertheless constitute a good starting point for the establishment of a new common currency policy.

We wanted to detect if there existed a general cointegrating relationship between the five series, and we decided therefore to carry out the FCVAR methodology on the five exchange rates. The hypothesis of having one fractional cointegration relationship between the series could not be rejected, being this a sign that cointegration between these exchange rates could be studied in the long memory fractional framework. Having used two lags, the resulting differencing parameter of the cointegrated system is 0.613 with a standard error of 0.037. The residuals appeared to be well behaved with no evidence of serial correlation. The fractional cointegration test results are presented in table 3 and the resulting VECM expression can be expressed

as follows:

$$\Delta^d \begin{pmatrix} \text{Burundian Franc} \\ \text{Kenyan Shilling} \\ \text{Tanzanian Shilling} \\ \text{Rwandan Franc} \\ \text{Ugandan Shilling} \end{pmatrix} - \begin{pmatrix} 0.001 \\ 0.022 \\ 0.001 \\ 0.002 \\ 0.001 \end{pmatrix} = L_d \begin{pmatrix} -0.09 \\ 0.135 \\ 0.039 \\ -0.021 \\ -0.06 \end{pmatrix} \nu_t + \sum_{i=1}^2 \Gamma_i \Delta^d L_d^i (X_t - \mu) + \varepsilon_t,$$

where the estimated adjustment coefficients α are shown in the vector preceeding ν_t , which is the stationary long-run equilibrium defined by $\nu_t = \beta'(X_t - \mu)$. The long-run effects that an external shock could have in the exchange rates of the EAC countries will most probably have opposite effects in Kenya and Tanzania compared to Burundi, Rwanda and Uganda, as shown by the opposite signs of their corresponding cointegrating long-run parameter values. In order to interpret these α coefficients we can consider an example of a shock to these exchange rates that pushes the system out of equilibrium. We ignore the short-run dynamics in Γ_i and we hold everything else fixed. In response to a fractionally lagged increase in ν_t , the fractional change in the exchange rate of the Rwandan Franc is given by its corresponding α coefficient, which is negative (-0.021), and therefore pushes the system back towards the equilibrium given by $\nu_t = 0$. In the same way, the positive α coefficient (0.039) of the Tanzanian Shilling exchange rate causes it to increase and also pushes the system back towards equilibrium. The magnitudes imply that the exchange rate of the Kenyan Shilling will move towards equilibrium quicker than all the other exchange rates, being the exchange rate of the Ugandan Shilling the slowest to reach that state. We wanted to compare the results from the FCVAR model with the ones that we would in principle obtain with the more traditional CVAR model, however the

cointegration null hypothesis was rejected for all possible ranks. This is because we need to take into account the long memory aspect of exchange rate series, and the best way to do so in a multivariate framework such as this one is by making use of the FCVAR. It is therefore through a fractional cointegration study that we can find a useful model that can enable policymakers to model and eventually forecast the effects of external shocks in the exchange rates of country unions such as the EAC.

Having analyzed the cointegrating features of the exchange rates in the EAC, we decided to check the evolution of the convergence in business cycles during the last years in the region, in order to test if EAC countries are affected by common fluctuations. We therefore analyzed the cyclical behavior of economic aggregates measured by GDP from 1960 up to 2011 in order to evaluate how EAC economies have evolved. Business cycle synchronization is widely used in the OCA literature as a tool to determine whether candidate countries present correlated trend and cyclical components of their macroeconomic indicators such as GDP. One of the most commonly used methods is the Hodrick-Prescott decomposition of GDP into trend and cyclical components. With annual data obtained from Pennworld Table we obtained the trends and cycles presented in Figure 2.

The graphical representation of the series shows how the five countries have undergone a considerable improvement in their Real GDP during the last decades, as shown by the positive trends. Uganda seems to be the country that has more smoothly undergone such increase in real GDP values, while the other four countries have suffered sharp declines at different points in time. In the case of Rwanda we can see a clear decrease in the level of real GDP clearly due to the tremendous consequences of the terrible genocide in the early 90s. In the case of Tanzania a series of economic policies grounded in socialist principles by directly investing in all sectors of the economy could be the explanation for the increase in its GDP at the end of the 80s, however poverty reemerged again by the start of the 90s. In Kenya

there was a very sharp decrease in GDP at the beginning of the 60s and a continuous decline during the 90s, the same that can be found for the case of Burundi. Only in the case of Uganda the increase in GDP has been smooth while in the other countries changes have taken place at different times and sometimes sharply. We finally present in table 4 the correlation of business cycles between the five EAC countries under study during the last five decades. We can see that most correlations are high and positive, providing thus more support to the establishment of a new currency in the EAC as its country members have experienced similar patterns of growth over the last decades.

One shall take a look at other African monetary unions that exist today in order to determine similarities and differences. Constituted by 14 countries sharing the CFA as common currency, the West African Economic and Monetary Union (WAEMU) and the Central African Economic and Monetary Community (CEMAC) have constituted a monetary union ever since its member countries gained independence. Although theoretically different, the two CFA currencies from each of the two regions are effectively interchangeable and have a fixed exchange rate to the euro. We can argue that there exist clear signs of heterogeneity among the member countries of the WAEMU and the CEMAC driven by internal political instability in some of them, and also a considerable lack of fiscal unity in the region, which is also the case still today for the EAC. These divergences among the country members of this monetary union arise despite the fact that this union has existed for a very long time, with the CFA as the currency used in the region for decades. It is therefore possible to consider that what keeps this union still in existence is not the necessary convergence of its member countries macroeconomic figures, but rather their common historical and traditional ties to the Francophone culture. Similar ties shall therefore be found and promoted within the country members of the EAC, since these will constitute an important base for the correct functioning of a new monetary union in eastern

Africa. Pegging the new EAC common currency to an international currency with a strong historical link such as the British pound could be an appropriate starting point.

7 Concluding Comments

In this work we have presented the first analysis of the real exchange rates in the East African Community based on fractional integration and cointegration, with the aim of testing the G-PPP theory. We show how by making use of the most innovative time series techniques both in the univariate and multivariate framework, researchers can capture the long memory components which are present in most macroeconomic variables such as exchange rates.

Though the presence of unit roots cannot be rejected in any of the EAC exchange rates, the fact that all the series are persistent brings us to consider the use of fractional cointegration in order to find both bivariate and general cointegrating relationships between the series under study. We show how there exist bivariate fractional cointegrating relationships between Tanzania and the rest of the EAC countries, and also between Rwanda, Burundi and Uganda. We conclude that with the recently introduced FCVAR methodology by Johansen and Nielsen (2012) a general fractional cointegration relationship can be found for the region exchange rates, which shall be add value to the grounds of forming a new monetary union in the region. The G-PPP can in principle be sustained from the obtained results, and the EAC countries can be considered to fulfill the exchange rate convergence requirements of the OCA theory.

Overall there exists enough evidence from this study to believe that there is a good base on which the East African Monetary Union should work in the coming years with the goal of achieving a common currency. Differences in the exchange rate

behavior still exist between the former British colonies and the other two smaller countries, however when analyzing their exchange rates the country members of the East African Community could in principle behave as an Optimal Currency Area. We suggest that this type of work shall be implemented into the study of other country areas that attempt to become currency unions in Africa such as the South African Development Community or the West African Monetary Zone. The use of fractional cointegration and especially the recently introduced fractionally cointegrated VAR model will provide useful results for policy makers and researchers interested in currency and country unions.

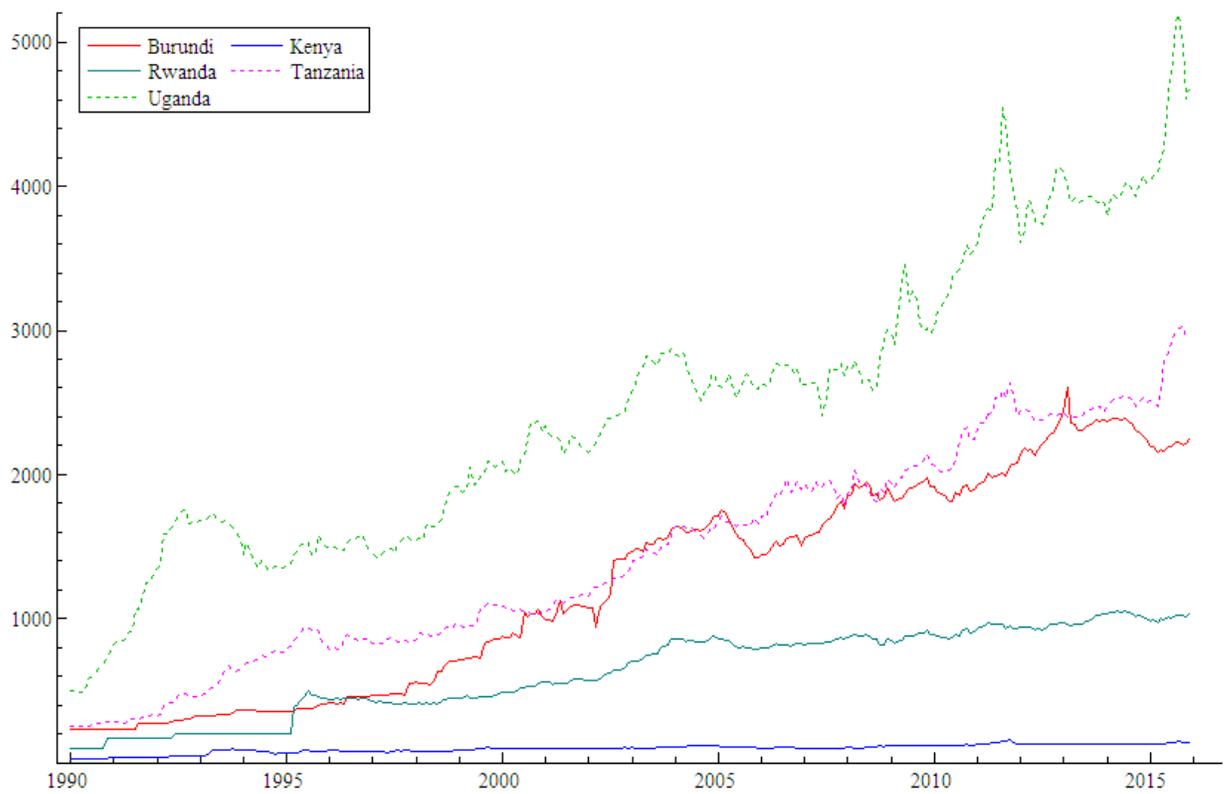


Figure 1: EAC Monthly Real Exchange Rates with respect to the US Dollar from 1990 up to 2015.

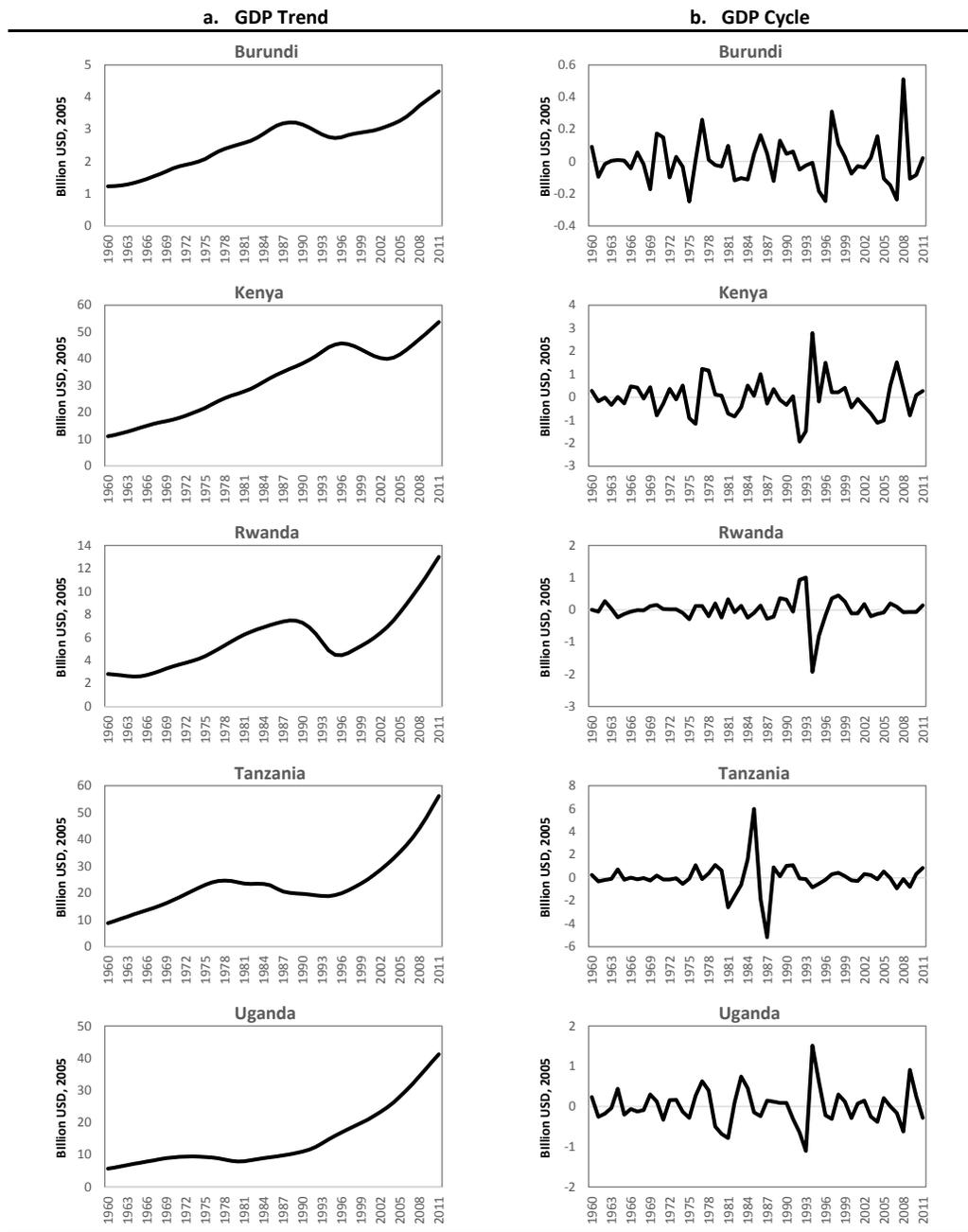


Figure 2: EAC Trend and Business Cycles from 1960 up to 2011 obtained with the Hodrick-Prescott filter.

Table 1: Estimates of d using the parametric approach in Robinson (1994).

EAC Country	Differencing Parameter (d)
Burundi	0.98 (0.88, 1.11)
Kenya	0.94 (0.82, 1.07)
Rwanda	1.01 (0.91, 1.15)
Tanzania	0.74 (0.65, 1.06)
Uganda	0.85 (0.75, 1.01)

There is evidence of long memory in all of the series, and the unit root or $I(1)$ case cannot be rejected for any exchange rate.

Table 2: Bivariate Fractional Cointegration relationships within the EAC.

	Burundi	Kenya	Rwanda	Tanzania
Kenya	0.127			
	0.938			
	0.987			
Rwanda	9.101	2.714		
	9.647	0.169		
	0.795	0.918		
Tanzania	4.241	10.066	6.613	
	2.463	1.844	3.971	
	0.933	0.883	0.887	
Uganda	0.198	0.004	0.348	12.930
	2.463	1.214	7.745	23.129
	0.886	0.852	0.793	0.523

The first two values refer to the test statistics obtained using the Hausman test of Marinucci and Robinson (2001). The third value is the estimated value of d . In bold those cases where we reject the null hypothesis of no cointegration at the 5% level of confidence.

Table 3: Fractional Cointegration rank test results.

Rank	d	LR Statistic	Log-likelihood	p-value
0	1.069	55.22	-6922.917	0.000
1	0.613	27.37	-6908.900	0.013
2	0.212	12.46	-6896.490	0.312
3	0.215	4.57	-6888.124	0.512
4	0.286	0.95	-6885.441	0.876

The null hypothesis of having one cointegrating rank cannot be rejected. A fractional cointegrated system can be found between the series with a differencing parameter value of 0.613.

Table 4: GDP Business Cycle correlations between EAC countries for the period 1960-2011.

	Burundi	Kenya	Rwanda	Tanzania	Uganda
Burundi	1				
Kenya	0.8884	1			
Rwanda	0.9445	0.7543	1		
Tanzania	0.8760	0.7067	0.9033	1	
Uganda	0.8317	0.7548	0.7977	0.9040	1

Pearson's correlation coefficient, commonly called simply the correlation coefficient, is obtained by dividing the covariance of the two variables by the product of their standard deviations.

References

Baillie, R.T. and T. Bollerslev (1994) Cointegration, Fractional Cointegration and Exchange Rate Dynamics, *Journal of Finance* 49, 2, 737-745.

Baum, C.F., J.T. Barloulkas and M. Caglayan (1999) Exchange Rate Uncertainty and Firm Profitability, *Journal of Macroeconomics* 23, 4, 565-576.

Booth, G., F.R. Kaen and P.E. Koveos (1982) R/S analysis of foreign exchange rates under two international monetary regimes, *Journal of Monetary Economics* 10, 407-415.

Buigut, S. K. and N. T. Valev (2005) Is the proposed East African Monetary Union an optimal currency area? A structural vector autoregression analysis, *World Development* 33, 12, 2119-2133.

Cheung, Y.W. (1993) Long Memory in Foreign Exchange Market, *Journal of Business and Economics Statistics* 11, 1, 93-101.

Dahlhaus, R (1989) Efficient parameter estimation for self-similar process, *Annals of Statistics* 17, 1749-1766.

De Gauwre, P. (2009) Economics of Monetary Union, Oxford University Press, 8th ed.

De Truchis, G. and B. Keddad (2013) Southeast Asian monetary integration: New evidences from fractional cointegration of real exchange rates, *Journal of International Financial Markets, Institutions and Money* 2, 394-412.

Diebold, F.X., S. Husted and M. Rush (1991) Real exchange rates under the gold standard, *Journal of Political Economy* 99, 1252-1271.

Enders, W. and S. Hurn (1994) Theory and Tests of Generalized Purchasing-Power Parity: Common trends and real exchange rates in the Pacific Rim, *Review of International Economics* 2, 2, 170-190.

Gil-Alana, L.A. and J. Hualde (2009) Fractional Integration and Cointegration: An Overview and an Empirical Application, *Palgrave Handbook of Econometrics* 434-469.

Guillaume, D.M. and D. Stasavage (2000) Improving policy credibility: Is there a case for African Monetary Unions?, *World Development* 28, 8, 1391-1407.

Johansen, S. (1996) Likelihood based inference in cointegrated vector autoregressive models, Oxford University Press.

Johansen, S. (2008) A representation theory for a class of Vector Autoregressive Models for fractional models, *Econometric Theory* 24, 3, 651-676.

Johansen, S. and M.Ø. Nielsen (2010) Likelihood inference for a nonstationary fractional autoregressive model, *Journal of Econometrics* 158, 51-66.

Johansen, S. and M.Ø. Nielsen (2012) Likelihood inference for a Fractionally Cointegrated Vector Autoregressive Model, *Econometrica* 80, 6, 2667-2732.

Mafusire, A. and Z. Brixiova (2013) Macroeconomic Shock Synchronization in the East African Community, *Global Economy Journal* 13, 2, 261-280.

Marinucci, D. and P.M. Robinson (2001) Semiparametric fractional cointegration analysis, *Journal of Econometrics* 105, 225-247.

Mundell, R. (1961) A Theory of Optimum Currency Areas, *Papers and Proceedings of the American Economic Association* 51, 657-664.

Nelson, C.R. and C.I. Plosser (1982) Trends and random walks in macroeconomic time series: Some evidence and implications, *Journal of Monetary Economics* 10, 2, 139-162.

Nielsen, M.Ø. and L. Morin (2016) A Matlab program and user's guide for the fractionally cointegrated VAR model, QED Working Paper 1330, Queens University.

Robinson, P. M. (1994) Statistical inference for a random coefficient autoregressive model, *Scandinavian Journal of Statistics* 5, 163-168.

Rose, A. K. (2004) A meta-analysis of the effect of common currencies on international trade, *Journal of Economic Surveys* 19, 3, 347-365.

Yabara, M. (2014) Assessing exchange rate dynamics of East Africa: fragmented or integrated? *Macroeconomics and Finance in Emerging Market Economies* 7, 1, 154-174.