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EXCHANGE RATE DYNAMICS AND MONETARY UNIONS IN AFRICA: A FRACTIONAL INTEGRATION AND COINTEGRATION ANALYSIS

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Abstract

This paper uses fractional integration and cointegration techniques to analyse nominal exchange rate dynamics in three groups of African countries aiming to form currency unions in the near future. The proposed unions are the WAMZ (West African Monetary Zone), the EAC (East African Community), and the SADC (South African Development Community). The univariate results indicate that in all but three countries (Democratic Republic of Congo, Mauritius and Madagascar) the nominal exchange rate series exhibit a unit root. Concerning the multivariate results, for the WAMZ cointegration is only found in the case of Ghana with both Gambia and Guinea; for the EAC for Rwanda with Burundi, and Tanzania with both Rwanda and Uganda. Finally, for the SADC, cointegration is found in only 15 out of 66 cases, including Swaziland with South Africa, Zambia with Malawi, and Mozambique with both Lesotho and Tanzania. Overall, our results suggest that convergence of exchange rates is far from having been achieved in each of the three unions considered.

Keywords: Monetary Unions, Africa, Exchange Rates

JEL classification: C22, C32, E31, F15

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1. Introduction

In this paper we examine nominal exchange rate dynamics in three groups of African countries that are intending to form currency unions in the near future. The proposed unions are the following: the West African Monetary Zone (WAMZ), formed by

West African Monetary Zone (WAMZ)

Constituted by six countries, this area of mostly Anglophone West African countries aims to adopt a single currency named the ECO in the near future, with the ultimate goal of joining the mostly francophone countries that belong to the West African Economic and Monetary Union (WAEMU or UEMOA from the French *Union Economique et Monétaire Ouest Africaine*), that have already been a monetary union for decades with the CFA as their currency. The members of the Economic Community of Central States (ECCS or CEMAC from the French *Communauté Économique des États de l'Afrique Central*) sharing the CFA as their common currency with the members of WAEMU will not be part of this monetary union since they are not members of the Economic Community of West African States (ECOWAS). At the moment the members of the WAMZ are Gambia, Guinea, Ghana, Liberia, Nigeria and Sierra Leone.

East African Community (EAC)

The East African Community (EAC) is an intergovernmental organisation comprising five countries in the African Great Lakes region in eastern Africa: Burundi, Kenya, Rwanda, Tanzania and Uganda. It was originally founded in 1967, but collapsed in 1977. Kenya, Tanzania and Uganda signed the Treaty for the 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. In 2008, after negotiations with the Southern Africa Development Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA), the EAC agreed to an expanded free trade area including the member states of all three, thus becoming an integral part of the African Community. The East African Community is a potential

precursor to the establishment of an East African Federation. In 2010 the EAC launched its own common market for goods, labor and capital within the region, with the goal of creating a common currency union and eventually a full political federation. In November 2013 a protocol was( )-39.000019-39(w)(y)20(na9(n)-9ut)-1(l)-1(i)-1(ni)-1(ng)10( )-39(t)-11(

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3. Literature Review

Most of the literature on African monetary unions concerns the current aim of creating a new currency area known as the ECO. This currency union of Anglophone West African countries could come into existence

the EAC treaty in 1999. Several authors have studied the viability of a monetary union in the EAC using different models and reaching different conclusions. For example, Buigut and Valev (2005) estimated a two-variable SVAR model to test for shock correlations in the EAC countries; they found that forming a monetary union in the EAC is not feasible. Mkenda (2001) and Falagiarda (2010) instead employed the G-PPP approach based on cointegration analysis and concluded that a monetary union in East Africa could be a viable option. Lastly, Sheikhet al. (2011) and Opolot and Osoro (2004) studied the feasibility of forming a monetary union in the EAC using the business cycle synchronisation approach based on the Hodrick-Prescott and Baxter-King filter; they found a low degree of synchronisation between EAC members, but this appears to have become stronger in recent years.

The United Nations Economic Commission for Africa (2011) has addressed the challenges of macroeconomic policy convergence in the SADC region. According to Bala (2011), there are only few convergence studies focusing on Sub-Saharan Africa, and even less dealing with SADC, which suggests that there is room for further empirical investigations. Kumo (2011) analysed growth and macroeconomic convergence in southern Africa, showing with ADF unit root tests that Botswana and South Africa's real per capita GDPs converge to a common stochastic trend, while GDP in the other countries is characterised by a drift. Breitenbach et al. (2014) tested PPP in the SADC economies and found non-linearities in the real exchange rates in SADC. Taulas (2008) surveyed the possible benefits of forming a monetary union in Southern Africa.

4. Methodology

We start by carrying out unit roots tests (ADF, Dickey and Fuller, 1979; Kwiatkowski et al., KPSS, 1992; and Elliot et al., ERS, 1996) on the original and the first differenced data. Then, since such tests have very low power if the true Data Generating Process (DGP) is fractionally integrated,[1] we also estimate the order of integration of the series applying fractional integration techniques, specifically a parametric Whittle method in the frequency domain (Dahlhaus, 1989) and a semiparametric one using only a band of frequencies close to zero (Robinson, 1995).

Next, we test

degree of integration of the two series, we test the null hypothesis of no cointegration using the Hausman test of Marinucci and Robinson (2001), comparing the estimate $\hat{d}_x$ of d_x with the more efficient bivariate one of Robinson (1995), which uses the information that $d_x = d_y = d_*$. Marinucci and Robinson (2001) show that

$$m\,\hat{d} \qquad \hat{d} \qquad \text{as} \quad \frac{1}{m} \quad \frac{m}{T} \qquad 0,$$

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5.2. Unit Root Tests

First of all we carry a battery of unit root tests (the Augmented Dickey-Fuller test (ADF, 1979); Kwiatkowski, Phillips, Schmidt and Shin (KPSS, 1992) and Elliott, Rothenberg and Stock (ERS, 1996) tests) on the nominal exchange rate series for twenty-five countries grouped in three different unions. These are the EAC, including Burundi, Kenya, Rwanda, Tanzania and Uganda; the WAMZ, including Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leona; and finally the SADC, including Angola, Botswana, Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania (also a member of the EAC union), Zambia and Zimbabwe.

[Insert Tables 1 and 2 about here]

In all cases we obtain strong evidence of unit roots in the original series, and I(0) stationarity in the first differences

1). In all the other cases we find at least one case when the unit root null cannot be rejected.

[Insert Tables 3 and 4 about here]

Table 4 displays the estimates of d using the "local" Whittle semiparametric method of Robinson (1995). Since the series are clearly nonstationary, first differences were taken for estimating d, then adding 1 to obtain the estimates.[4] We present the results for a selected number of bandwidth parameters m = 11, 12, …, 14 and 15 (≈ $T^{0.5}$), …, 18 and 19: they are generally consistent with the parametric ones reported in Table 3. For the Democratic Republic of Congo and Mauritius the estimated values of d are significantly above 1 practically in all cases; on the contrary, for Madagascar and Sierra Leone the estimates are below 1, which implies mean reversion, i.e. in these two countries the effects of shocks disappear over time without the need for policy actions. A tight monetary policy that has brought inflation down to single-digit figures, and has limited central bank intervention to smoothing out major exchange rate fluctuations, is the likely explanation for this finding in the case of Ma\dagascar and Sierra Leone.

5.4 Fractional Cointegration

Next we examine nominal exchange rate linkages within each prospective currency union. A necessary condition for cointegration in a bivariate context is that the two parent series should display the same degree of integration. Therefore, the first step is to test for homogeneity in the order of integration of the series: only for Sierra Leone (in the WAMZ) and the Democratic Republic of Congo, Madagascar and Mauritius (for the SADC group) evidence against homogeneity is found, and therefore these exchange rate series are not included in the fractional cointegration analysis.

[4] Extensions of this method to the nonstationary case have been developed by Velasco (1999), Phillips and Shimotsu (2004) and Abadir et al. (2007) among others. These methods, however, require additional user-chosen parameters.

Table 5 reports the cointegration results for the three unions considered. In the case the WAMZ (see Table 5a) we only find evidence of cointegration between the series for Ghana and those for both Gambia and Guinea; i

African Community), including Burundi, Kenya, Rwanda, Tanzania and Uganda; and the SADC (South African Development Community) including Angola, Botswana, Dem. Rep. of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

The univariate analysis uses standard unit root tests which indicate that all series are nonstationary, and fractional integration methods providing evidence of orders of integration higher than 1 in the cases of the exchange rates of the Democratic Republic of Congo and Mauritius, and

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Table 1: Unit root test results (level)

Regions	Countries	ADF		KPSS		ERS	
		Intercept	Trend	Intercept	Trend	Interceptpt	Trend
WAMZ	Gambia	-1.527067	-0.950206	1.622184***	0.404449***	257.8544	47.46977
	Guinea	-1.526386	-1.336676	1.823357***	0.400357***	205.5206	18.50168
	Ghana	-2.887584**	-2.970222	0.275831	0.091932	1.325387***	4.079491**
	Liberia	-2.682296*	400278W1200234				

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Table 2: Unit root test results (first differences)

Regions	Countries	ADF	KPSS

Table 3: Fractional integration results

Regions	Countries	White noise	AR (1)	Bloomfield
WAMZ	Gambia	1.20 (1.11, 1.31)	**1.07 (0.98, 1.19)**	**1.08 (0.97, 1.20)**
	Guinea	**0.95 (0.87, 1.04)**	**0.92 (0.81, 1.07)**	**0.93 (0.81, 1.07)**
	Ghana	**0.95 (0.84, 1.07)**	**0.84 (0.59, 1.09)**	**0.80 (0.56, 1.07)**
	Liberia	**1.00 (0.91, 1.12)**	**0.81 (0.71, 1.13)**	**0.90 (0.72, 1.13)**
	Nigeria	**1.13 (1.04, 1.28)**	**0.85 (0.76, 1.09)**	**0.93 (0.78, 1.12)**
	Sierra Leone	1.24 (1.11, 1.41)		

parametric approach

14	15	16	17	18	19
1.214	1.214	1.354	1.288	**1.192**	**1.178**
1.196	**1.185**	**1.159**	**1.173**	**1.119**	**1.168**
0.749	0.768	**0.791**	**0.810**	**0.843**	**0.874**
0.789	**0.819**	**0.877**	0.779	**0.819**	**0.825**
1.006	**0.998**	**0.994**	**0.985**	**0.978**	**0.981**
0.407	0.407	0.406	0.429	0.454	0.469
1.074	**1.027**	**1.051**	**1.069**	**1.069**	**1.062**
0.955	**0.951**	**0.909**	**0.942**	**0.973**	**0.975**
1.066	**1.043**	**0.978**	**0.978**	**0.990**	**1.015**
1.118	**0.955**	**0.966**	**0.978**	**0.951**	**0.913**
0.793	**0.846**	**0.826**	**0.856**	**0.903**	**0.888**
1.166	**1.086**	**1.003**	**0.945**	**0.917**	**0.910**

Table 5a: Testing the null of no cointegration: WAMZ

	Gambia	Guinea	Ghana	Liberia	Nigeria
Guinea	0.151 0.348 1.044	---	---	---	---
Ghana	**10.494** **67.500** **0.540**	**7.871** **63.712** **0.442**	---	---	---
Liberia	1.141 33.641* 0.693	1.314 32.235* 0.686	2.030 0.981 0.661	---	

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