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**REER Imbalances and Macroeconomic Adjustments: evidence from the  
CEMAC zone<sup>1</sup>**

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**Abstract**

The EMU crisis holds special lessons for existing monetary unions. We assess the behavior of real effective exchange rates (REERs) of members of the Central African Economic and Monetary Community (CEMAC) zone with respect to their long-term equilibrium paths. A reduced form of the fundamental equilibrium exchange rate (FEER) model is estimated and associated misalignments. Our findings suggest that for majority of countries, macroeconomic fundamentals have the expected associations with the exchange rate fluctuations. The analysis also reveals that only the REER adjustments of Cameroon and Gabon are significant in restoring the long-term equilibrium in event of a shock. The Cameroonian economic fundamentals of terms of trade, government expenditure and openness have different long-term relations with the REER in comparison to those of other member states. There is no need for an adjustment in the level of the peg based on the present quantitative analysis of REER paths.

*JEL Classification:* F31; F33; F42; F61; O55

*Keywords:* Exchange rate; Macroeconomic impact; CEMAC zone

## 1. Introduction

The euro area has come under immense pressure after its first decade. Triggered by adjustments in the fiscal accounts of Greece, the crisis which initially spread to Ireland and Portugal has become a threat to the euro zone's existence after Spanish and Italian sovereigns began experiencing funding pressures. This crisis reflects banking sector fragilities and intertwined public debt made worse by apparently weak growth outlooks, as well as substantial gross and net external liabilities<sup>2</sup>. German firms have continued their outward integration by setting-up production platforms in emerging Europe in order to take advantage of higher return on capital and lower wage costs which boosted competitiveness and exports. This easy financing continued until the crisis erupted and allowed deficit countries to sustain appreciating real effective exchange rates (which have also been driven by the nominal appreciation of the euro) and has delayed the adjustment needed to end the growing divergence of trade performance within the monetary union (Chen et al., 2012). The debate in the literature on structural adjustment and macroeconomic stabilization has emphasized the crucial role played by real exchange rate (owing to the importance of export promotion) for the generation of optimal paths of employment and output (Abdih & Tsangarides, 2010). The maintenance of exchange rates at an appropriate level has been credited for the success of certain developing countries. In the same vein, it is believed that a distinguishing feature of East and Southeast Asia's success with sustainable growth has been the consistent avoidance of overvaluation (Abdih & Tsangarides, 2010).

The spectre of the Euro crisis is hunting existing and embryonic monetary unions. Recent studies have shown that proposed African monetary unions of East and West Africa are not optimal currency areas (Asongu, 2014a, 2014b). In the same light, real, monetary and fiscal policy convergence is absent within the Central African Economic and Monetary Community

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<sup>2</sup> For instance, net external liabilities of close to 100% of GDP in Greece, Ireland, Portugal and Spain.

(CEMAC) CFA franc zone (Asongu, 2013). The CFA franc arrangement dates back to the mid-1940s and is one of the longest-standing fixed exchange rate regimes in the world. This currency was devalued once in 1994, when a 50% adjustment in the nominal rate reversed domestic and external disequilibria that had built-up since the mid-1980s. Over the period 2002 to 2005, the CFA franc appreciated (by more than 30% in nominal terms vis-à-vis the US dollar) along with the euro to which it is pegged. This appreciation has led to a renewed interest in the prospects of and outlook for the CFA franc and reignited the debate on the sustainability of the peg, including whether the same peg to the euro for both monetary unions continues to be appropriated (Abdih & Tsangarides, 2010).

In light of the above, assessing the competitiveness of the CFA zone requires quantitative analysis of the actual and equilibrium exchange rates as well as adjustments of macroeconomic fundamentals to corresponding exchange imbalances. Previous empirical work on the CFA franc currency valuation has focused on the first few years after the 1994 devaluation, with particular interest of some studies in how real exchange rate misalignments were corrected by the 1994 change in parity (Ahlers & Hinkle, 1999). To the best of our knowledge, studies on the effects of the recent appreciation of the euro on the CFA franc are scanty. Abdih & Tsangarides (2010) have recently evaluated whether the CFA franc is currently significantly over-valued from its equilibrium rate and concluded that the currency is not over-valued. While panel-based results as presented by Abdih & Tsangarides (2010) are important, they fail to account for country-specific dynamics that could have relevant policy implications. This is because, like in the current euro crisis, macroeconomic fundamentals maybe different across CFA franc countries. Hence, the need for country-specific analyses to complement existing literature.

In this article, we analyze the movements of the actual real effective exchange rate (REER) for countries within the CEMAC zone vis-à-vis long-term values. The rest of the paper

is organized as follows. Section 2 presents the data and methodology. The empirical analysis and corresponding discussion are covered in Section 3. Section 4 concludes.

## **2. Data and Methodology**

We examine a sample of 4 CEMAC countries (Cameroon, Central African Republic, Gabon and Equatorial Guinea) due to constraints in data availability. The data include the following variables: the REER, productivity, government expenditure, TOT, investment and openness. The first-two variables are presented in terms of natural logarithm to ease comparability and compatibility. Definitions of variables (with corresponding) sources is presented in the Appendix.

Consistent with Abdih & Tsangarides (2010), we employ a Vector Error Correction Model (VECM). Application of the VECM presupposes the exhibition of unit roots in levels and the existence of a long-run equilibrium (cointegration). First, we employ the Augmented Dickey Fuller (ADF) test for unit roots or the order of integration of the series. Next, the Johansen (1995) maximum likelihood procedure is used to test for the corresponding long-run cointegration relationships between the exchange rate and its fundamentals. Then, the equilibrium levels of the fundamentals are computed specifically by extracting the permanent component from the fundamentals' series. Finally, the vector of long-term parameters and the extracted permanent component are combined to calculate the EREER, with the misalignment estimated as the shift of the REER from its value in equilibrium.

## **3. Empirical analysis**

### **3.1 Integration and cointegration analysis**

We perform the standard ADF tests both in levels and first differences of the variables under consideration. Optimal length selection for goodness of fit in the ADF specification is by the Akaike Information Criterion (AIC). From the reported  $t$ -ADF statistics in Table 1, but for

investment in the Central African Republic (CAR), we cannot reject the null hypothesis of a unit root for all the variables in levels. However, the null of a unit root in first difference is strongly rejected. Hence, we conclude that the variables are overwhelmingly integrated in the first order; this is, they can be differenced once to obtain stationarity.

**Table 1: ADF unit root test for variables**

Countries	Variables	Level		First difference	
		c	ct	c	ct
Cameroon (1980-2009)	REER(ln)	-1.421	-2.020	<b>-3.828***</b>	<b>-3.750**</b>
	TOT	<b>-2.693*</b>	-2.636	<b>-5.185***</b>	<b>-5.201***</b>
	Gov't Spending	-2.491	-2.575	<b>-4.441***</b>	<b>-4.497***</b>
	Openness	-1.593	-1.182	<b>-3.327**</b>	<b>-3.764**</b>
	Productivity(ln)	-1.424	-2.105	<b>-3.401**</b>	<b>-3.391*</b>
	Investment	-1.912	-1.243	<b>-3.324**</b>	<b>-3.429**</b>
Central African Republic (1980-2009)	REER(ln)	-1.287	-0.964	<b>-4.064***</b>	<b>-4.181***</b>
	TOT	-1.962	-1.988	<b>-4.735***</b>	<b>-4.656***</b>
	Gov't Spending	-0.547	-2.511	<b>-5.413***</b>	<b>-5.833***</b>
	Openness	-2.178	-2.746	<b>-5.916***</b>	<b>-6.020***</b>
	Productivity(ln)	-1.424	-2.105	<b>-3.401**</b>	<b>-3.391*</b>
	Investment	<b>-3.030**</b>	<b>-3.444**</b>	n.a	n.a
Gabon (1980-2009)	REER(ln)	-1.085	-1.099	<b>-3.931***</b>	<b>-3.986***</b>
	TOT	-2.216	<b>-3.336*</b>	<b>-5.428***</b>	<b>-5.322***</b>
	Gov't Spending	-1.861	<b>-3.384*</b>	<b>-3.901***</b>	<b>-3.752**</b>
	Openness	-2.057	-1.999	<b>-3.792***</b>	<b>-3.721**</b>
	Productivity(ln)	-1.424	-2.105	<b>-3.401**</b>	<b>-3.391*</b>
	Investment	-2.179	-2.586	<b>-5.600***</b>	<b>-5.507***</b>
Equatorial Guinea (1985-2009)	REER(ln)	-1.476	-1.311	<b>-3.223**</b>	<b>-4.455***</b>
	TOT	-0.666	-2.193	<b>-2.617*</b>	-2.259
	Gov't Spending	-0.639	-2.529	<b>-4.763***</b>	<b>-4.581***</b>
	Openness	-1.689	-1.441	<b>-2.871**</b>	-2.839
	Productivity(ln)	-1.429	-2.454	<b>-3.379**</b>	<b>-3.304*</b>
	Investment	-1.243	-1.504	-2.553	-2.692

Notes. \*\*\*, \*\*, \*: denote significance at 1%, 5% and 10% respectively. 'c' and 'ct': 'constant' and 'constant and trend' respectively. REER: Real Effective Exchange Rate. TOT: Terms of Trade. Gov': Government. ln: logarithm.

From the results presented in Table 2 below, there is evidence of a long-run relationship between the REERs and their identified fundamentals for all the four countries under consideration.

**Table 2: Johansen cointegration test**

		Eigenvalue	Trace test	Max-Eigen test
Cameroon	None	0.905	<b>164.96***</b>	<b>61.428***</b>
	At most 1	0.793	<b>103.53***</b>	<b>43.332***</b>
	At most 2	0.675	<b>60.202**</b>	<b>30.593**</b>
	At most 3	0.440	29.609	16.069
	At most 4	0.308	13.541	7.943
	At most 5	0.183	5.597	5.597
Central African Republic	None	0.675	<b>81.161**</b>	31.477
	At most 1	0.553	49.685	22.573
	At most 2	0.410	27.112	14.817
	At most 3	0.277	12.295	9.114
	At most 4	0.107	3.180	3.180
	At most 5	n.a	n.a	n.a
Gabon	None	0.833	<b>128.97***</b>	<b>50.269***</b>
	At most 1	0.606	<b>78.703**</b>	26.138
	At most 2	0.581	<b>52.565*</b>	24.377
	At most 3	0.457	28.188	17.145
	At most 4	0.200	11.043	6.271
	At most 5	0.156	4.771	4.771
Equatorial Guinea	None	1.000	<b>1362.2***</b>	<b>612.74***</b>
	At most 1	1.000	<b>749.46***</b>	<b>600.96***</b>
	At most 2	0.985	<b>148.50***</b>	<b>71.804***</b>
	At most 3	0.950	<b>76.695***</b>	<b>51.212***</b>
	At most 4	0.665	<b>25.483***</b>	<b>18.604**</b>
	At most 5	0.332	6.879	6.879

Notes. \*\*\*, \*\*, \*: denote significance at 1%, 5% and 10% respectively. ‘c’ and ‘ct’: ‘constant’ and ‘constant and trend’ respectively. Model specification is by AIC with 2 maximum lags.

With condition (ii) satisfied, the VAR can be expressed as a VECM:

$$\Delta Y_t = \pi_0 + \alpha \beta' Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \psi D_t + e_t \quad (1)$$

The matrix  $\beta'$  contains the cointegrating vector(s) and the matrix has the weighting elements for the  $r$ th cointegrating relation in each equation of the VAR. The matrix rows of  $\beta' Y_{t-1}$  are normalized on the variable(s) under consideration in the cointegrating relation(s) and interpreted as deviations from the long-term equilibrium condition(s). In this context, the column of  $\alpha$  represents the speed of adjustment to the long-term equilibrium. The estimated vector can be used to provide a measure of the EREER and also quantify the misalignment margin between the prevailing exchange rate and its equilibrium level. The estimated  $\alpha$  associated with the REER captures the speed at which the real exchange rate converges to the equilibrium state.

### 3.2 Cointegration coefficients and adjustments

We have observed from Table 2 that, there is evidence of a long-term relationship between the REERs and their identified fundamentals in the four CEMAC countries investigated. Table 3 contains the results from estimating the VAR/VECMs in Eq. (1) for each of the four countries. The table is divided into two panels, with Panel A reporting estimates for the cointegrating vectors (the  $\beta s$ ) together with their standard errors and Panel B reporting the adjusting (feedback) coefficients estimates (the  $\alpha s$ ) and their t-statistics. The resulting cointegration equations have some signs that are consistent with the predictions from economic theory, while some do not. These asymmetric country-specific dynamics cannot be obtained from a panel-based analysis and thus, provide justification for our problem statement and the complementary character of the present study with respect to Abdih & Tsangarides (2010).

From Panel A, the following could be established. (1) With the exception of Cameroon, the TOT are positively correlated with the REER indicators such that, an improvement in the TOT would result in an appreciation of the long-run EREER through a possible wealth-effect. The Cameroonian case implies that, an increase in the TOT does not lead to an increase in non-tradables through the wealth-effect. (2) With the exception of the CAR, government consumption has a positive (appreciating) impact on REER, suggesting that most government spending is directed towards non-tradables. (3) But for Cameroon, increases in openness are associated with depreciation of the REER through increases in imports. (4) The relative high long-term impact of technological progress (proxied by the relative real GDP per capita) confirms the Balassa-Samuelson effect for Gabon and Equatorial Guinea. Hence, productivity in Cameroon and the CAR does not lead to an increase in the export of tradables and corresponding increase in wages and demand for non-tradables that ultimately appreciate the REER. (5) Investment is negatively correlated with the REER only in Cameroon, confirming

the hypothesis that investment has a high import content and increases spending towards tradable goods. This is not the case with the other countries.

**Table 3: Cointegration and short-term adjustment coefficients**

	Cameroon	Central A. R	Gabon	Equatorial G.
<b>Panel A: Estimates of cointegration relationships</b>				
TOT	-3.557[0.641]	1.886[0.232]	2.678[0.508]	0.862[0.000]
Gov't Spending	0.262[0.040]	-0.039[0.009]	0.364[0.044]	0.097[0.000]
Openness	0.026[0.009]	-0.017[0.004]	-0.030[0.014]	-0.006[0.000]
Productivity(ln)	-0.306[0.213]	-0.049[0.108]	2.425[0.281]	0.392[0.000]
Investment	-0.151[0.033]	---	0.030[0.027]	0.024[0.000]
constant	1.523[3.213]	-4.396[1.276]	-35.844[3.654]	-11.525[0.000]
<b>Panel B: Estimates of short term adjustment coefficients</b>				
D[REER(ln)]	<b>-0.153(-4.083)***</b>	0.009(0.049)	<b>-0.074(-2.355)**</b>	-0.036(-0.852)
D[TOT]	<b>0.143(2.169)**</b>	<b>-0.352(-2.660)**</b>	<b>-0.196(-1.868)*</b>	<b>-0.501(-2.874)**</b>
D[Gov't Spending]	<b>-0.918(-1.951)*</b>	<b>14.281(4.771)***</b>	-0.723(-0.949)	2.081(0.606)
D[Openness]	3.940(1.525)	13.06(1.223)	-0.086(-0.029)	37.100(1.603)
D[Productivity(ln)]	0.038(0.866)	0.072(0.504)	0.000(0.035)	-0.009(-0.304)
D[Investment]	<b>-2.073(-2.817)**</b>	---	2.210(1.120)	<b>20.479(1.952)*</b>

Notes. \*, \*\*, \*\*\*: denote significance levels at 10%, 5% and 1% respectively. Model specification is by AIC with 2 maximum lags. The deterministic trend assumption is a restricted constant. [ ]: standard errors. ( ): t- statistics. D [ ]: First difference.

Panel B of Table 3 shows the feedback coefficients for the cointegrating vectors or the short-run relationships of the REER and its fundamentals. Some adjustments are significantly different from zero, implying that these fundamentals are not weakly exogenous with respect to the parameters of the cointegration relationship. In the face of any deviation from the long-term equilibrium, these variables jointly respond and adjust the system back to equilibrium. The fundamentals of Cameroon are significantly strong in adjusting the system to the equilibrium. Openness and productivity are not significant fundamentals in adjusting the REER of all countries under consideration. Conversely, the TOT is a significant instrument for adjusting the REER in all countries, followed by government spending and investment in two of the four countries. Furthermore, the feedback coefficient for the REER is only significant for Cameroon and Gabon, confirming these countries as the backbones of the CEMAC economy. The significant negative adjusting terms of the 'REER change' for these two countries also suggest the stability of the error correction mechanism. As a matter of principle, the speed of

adjustment of the parameters should be between zero and ‘minus one’ (0, -1). If the Error Correction Terms (ECTs) are not within this interval, then either the model is misspecified (and needs adjustment) or the data is inadequate (perhaps owing to issues with degrees of freedom).

#### **4. Conclusion and policy recommendations**

With the help of a dynamic model of a small open economy and the Johansen cointegration methodology, the REERs have been analyzed for countries in the CEMAC zone. The objective has been to analyze REERs imbalances and assess whether the movements in the aggregate real exchange rates are consistent with the underlying macroeconomic fundamentals. We have shown that, from country-specific perspectives, the long-term behavior of the REERs can be explained by fluctuations in government expenditure, terms of trade, openness, productivity and investment. We have found evidence of significant misalignments in the REER only in Cameroon and Gabon. The negative feedback terms of the exchange rates suggest that adjustments will restore the long-run equilibrium. Had the adjustments been positively significant, this would have implied a further deviation from the long-run equilibrium to a new equilibrium. Hence, we can infer that based on the available weight of evidence, there is yet no imperative for an immediate adjustment in the level of the peg. In theory, fixed exchange rate regimes can be sustainable as long as actual deviations from long-term equilibrium rates are small and mean reverting. Conversely, if deviations are one-sided and build-up to longer term significant misalignments, it is generally argued that (in addition to demand-side management policies) real exchange rate action may be required to restore balance. Hence, based on the estimated paths there is yet not a very clear pattern of over-valuation as was the case prior to the 1994 devaluation.

As a policy implication, there is no need for an adjustment in the level of the peg based on the present country-specific quantitative analysis of the path of the REERs in the CEMAC zone. However, exhaustive analysis of the environment that affects the overall sustainability of

the CFA franc arrangement necessitates an examination of possible pressures on balance of payment flows, reserve levels, losses of competitiveness, sustained deviations from country-specific EREERs and unfavorable market perceptions. We have also observed that, with some exceptions, the impacts of the fundamentals on the REER are similar across countries. For fundamentals that did not meet expected signs (with respect to the REER), it is up to the authorities in place to adopt relevant measures to adjust the tendencies. This is particularly the case of Cameroon with respect to the terms of trade, government expenditure and openness.

## Appendix

### Appendix 1: Definitions of variables

Variables	Signs	Variables' definitions	Source
Real Effective Exchange Rate	REER	Natural Log. of REER	WDI (World Bank)
Terms of Trade	TOT	Exportable Commodities/Importable Commodities	WDI (World Bank)
Government Spending	Gov't	Government final consumption expenditure (% of GDP)	WDI (World Bank)
Openness	Trade	Imports plus Exports of Commodities (% of GDP)	WDI (World Bank)
Productivity	Prod.	Natural Log. of real GDP per capita.	WDI (World Bank)
Investment	Invt.	Gross Fixed Capital Formation (% of GDP)	WDI (World Bank)

Log: Logarithm. GDP: Gross Domestic Product. WDI: World Domestic Indicators.

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