The CFA Franc effect on trade

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Abstract - This paper aims to assess the effect of sharing the CFA franc on bilateral trade in the African Franc Zone (AFZ) since 1995. In the light of the endogenous theory of optimum currency, we estimate an augmented gravity model with the Poisson Pseudo Maximum Likelihood estimator, and obtain two major results: (*i*) the effect of CFA on the bilateral trade of the African Franc Zone member countries is positive, but different in the two zones, because of the specific characteristics of the countries; (*ii*) based on three modeled scenarios ("Aggregation", "Cooperation" and "Consolidation"), the results finally show that the two zones would all win if they merged to form a consolidated monetary union, which would tend to justify the ongoing reforms.

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Key-words
African franc zone
CFA Franc
Bilateral trade
Gravity model

1. INTRODUCTION

The single currency and bilateral trade nexus is founded in the endogeneous theory of optimal currency area (OCA). This theory opposes two main theses. On the one hand, the thesis of the vicious circle of OCA, which states that the transition to a single currency increases the specialization of countries according to their comparative advantages, which tends to make asynchronous cycles and to amplify the asymmetry of shocks (Krugman, 1993). On the other hand, the thesis of the virtuous circle of OCA, which shows that the single currency is a factor of business cycles synchronization (Frankel & Rose, 1998), an economic growth factor (Vickers, 2000), and a channel of market integration (Rose, 2000). This article aims at testing whether the CFA Franc has stimulated trade between the member countries of the African Franc Zone (AFZ).

Created in 1939 by France in its former colonies, the Franc Zone can be presented as one of the oldest monetary zones in the world. It is made up of France, the Central African Economic and Monetary Community (CAEMC) member countries (Cameroon, Congo, Central African Republic, Gabon, Equatorial Guinea and Chad), the West African Economic and Monetary Union (WAEMU) member countries (Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Niger, Mali, Senegal and Togo) and the Islamic Union of the Comoros. These countries and groups of countries use their respective currencies, namely the Euro for France, the African Financial Cooperation Franc for the CAEMC member countries, the African Financial Community Franc for the WAEMU member countries, and the Comorian Franc for the Comoros. The need to study the effect of the CFA franc on trade in the countries of the African Franc zone can be justified by the fact that this monetary zone is one of the oldest in the world. In addition, its member countries are engaged in other economic integration projects, in particular the African Union project. From this perspective, it becomes appropriate to evaluate one of the macroeconomic effects in terms of the commercial benefit of sharing this currency.

Empirically, the authorship of the work on the link between the single currency and market integration goes back to Rose (2000). In his analysis, he shows that countries that share the same currency trade on average three times more than the countries that have kept their individual currencies. His second result suggests that reducing exchange rate volatility - even at zero - does not lead to the same effects on trade as the adoption of the same currency.

In Africa, little attention has been paid to the link between the single currency and bilateral trade. Studies on the subject followed two ways. The first way focusses on existing monetary unions (in particular the AFZ). The results show that the African Franc Zone is not an optimal monetary zone, based on a static or exogenous analysis, but tends to validate its optimality according to the endogenous approach (Sampawende Tapsoba, 2007, 2009; Zhao & Kim, 2009). Recent work confirm globally the existence of the endogenous effects of a single currency (Couharde, Coulibaly, Guerreiro & Mignon, 2013; Coulibaly & Gnimassoun, 2013; Harvey & Cushing, 2015; Grekou, 2016). The second way focusses on the feasibility of potential currency unions in Africa. Most of the results lead to an optimistic consensus that endogenous mechanisms may be triggered over time to make the sharing of a single currency beneficial (Buigut & Valev, 2005; Houssa, 2008; Tsangarides & Qureshi, 2008).

The Franc Zone is a privileged field for the experimentation of these debates. However, we do not pretend to explore in this article all of them. It therefore seemed necessary to start by examining the nature of the relationship between the long-term monetary experience of member countries and their trade performance with each other and with their main partners. Thus, the main objective of this paper is to check whether the use of the CFA franc has been a factor of market integration in the CAEMC and the WAEMU. In other words, it aims at identifying the trade gains that the CFA francs would have generated in these two communities. More specifically, it is necessary to estimate the multiplier effect of sharing the CFA franc on the bilateral trade of the African Franc zone member countries and to simulate the same effect under three scenarios, in particular the «Aggregation scenario», the «Cooperation scenario» and the «Consolidation scenario».

The contribution of this paper lies on three levels. Firstly, it raises the question of the commercial integration of the Franc Zone in a context of monetary reforms, that of the WAEMU which must switch from June 2020 to a new currency area (the ECO zone), and that of the CAEMC currently in full harmonization of its tariff instruments with ECCAS with a view to projecting towards a single currency. Second, it addresses the monetary integration debate of the African franc zone through the prism of trade costs / gains, with a view to assessing the opportunity cost endured by the members' countries due to the absence of monetary reforms. Finally, we adopt some specifications of the variable of interest (sharing of the same currency) that we consider as reforms (scenarios) and we examine their potential effects on trade. For this, we adopt from the status quo, three scenarios, namely "Aggregation", "Cooperation" and "Consolidation".

Our empirical analyses highlights two key findings: (*i*) the effect of CFA on the bilateral trade of the African Franc Zone member countries is positive, but different in the two zones, because of the specific characteristics of the countries; (*ii*) based on three modeled scenarios ("Aggregation", "Cooperation" and "Consolidation"), the results finally show that the two zones would all win if they merged to form a consolidated monetary union.

Following this introduction, the rest of the paper is organized into four additional sections. Section 2 presents a brief literature review. Section 3 highlights the empirical strategy. Section 4 analyzes the main findings and addresses their robustness. Section 5 presents some concluding remarks.

2. SELECTED RECENT LITERATURE REVIEW

Recent works on the link between monetary union and trade tends to show that, while remaining positive, this link has differentiated and (a)symmetrical effects, but also dynamic and dimensional effects.

2.1. Differentiated and (a)symmetric effects

Questioning the direct effect of currency unions on market integration, Sadeh (2014) assesses the impact of the euro on the bilateral trade of the European Union member countries. He manages to show that because of the euro, the Mediterranean European States benefited more in trade compared to others. In addition, the euro would have increased the trade of European non-euro area countries by 35%. For Camarero, Gómez and Tamarit (2014), while the effect of the euro on trade has been greater than that of exchange rate coordination, they note, however, that when these variables are controlled in the model, the residual effect of the euro certainly remains positive and significant, but decreases quite significantly. For Glick and Rose (2016), the effect of the entry or exit of a monetary structure is symmetrical. They manage to demonstrate that the introduction of the euro has increased the bilateral trade of member countries by about 50%. Finally, by showing that different monetary unions produce different effects on bilateral trade, Glick and Rose (2016) provide an empirical solution to the generally encountered aggregation bias of the gravity model specifications. This approach inspires our empirical strategy when we develop several scenarios for the African franc zone.

2.2. Dynamic and dimensional effects

Since Rose (2000), there has been little work on the dynamic effects of currency unions on trade. They were interested in the nature of the link between the two variables, without addressing the question of the dynamics of this link over time. On the basis of this observation, Katayama and Melatos (2011) using the panel dataset constructed by Glick and Rose (2002) that covers 217 countries from 1948 to 1997, demonstrate the non-linear impact of the single currency on bilateral trade. Thus, they show that, contrary to previous studies, the sharing of a single currency does not influence the level of bilateral trade in the same proportion. After him, de Sousa (2012)'s study, based on a theoretical gravity model covering a large period (1948 to 2009) proves that the effect of sharing a single currency on bilateral trade is eroding over time, because of the existence of the other channels that are commercial and financial globalization.

This result remain robust and cherish by Miron, Miclaus and Vamvu (2013). The authors restate the result of Rose (2000) on the differentiated effects of the sharing of a single currency and the reduction of volatility of the exchange rate. Moreover, they confirm the hypothesis of the continuous declining effect of currency union on bilateral trade. According to Larch, Warner and Yotov (2018), the monetary union effects on trade are dimensional. Using a structural gravity model, the authors distinguish in the case of euro zone, bilateral and multilateral effects. They discover that both effects are positive and statistically significant. Globally, this set of results remain consistent with that previously established by Bergin and Lin (2012), using a different methodology

3. EMPIRICAL STRATEGY

3.1. The model

In this paper, we use the gravity model, which continues to be cited as a reference in international economics. This model experienced three essential historical evolutions in its formalization, namely the era of zero trade flows in the mid-1990s, the era of multilateral resistances popularized in the early years 2000, and the resurgence of a new literature that integrates the heterogeneity of firms in the late 2000s. Despite the existence of other competing methods, this model continues to emerge as a robust tool for modeling trade flows (Gervais, 2019; Baier, Yotov & Zylkin, 2019; Agnosteva, Anderson & Yotov, 2019; Santana-Gallego & Pérez-Rodríguez, 2019). The gravity model is based on the postulate of Newtonian physics, according to which the force of attraction between two bodies is proportional to the product of their relative masses and inversely proportional to the square of the distance separating them. The gravity model was first transposed into economics by Tinbergen (1962). But it is Anderson (1979) and then Anderson and van Wincoop (2003) who introduced the debate related to its theoretical foundations.

There are several specifications of the gravity equation. But in this paper we adopt the structural specification of Head and Mayer (2014) that puts interest on multilateral resistance terms:

$$X_{ij} = \frac{Y_i^a}{\Omega_i}\frac{Y_j^b}{\Phi_j}\phi_{ij} \quad (1)$$

Where $Y_i = \sum_j X_{ij}$ is the production of country i, $Y_j = \sum_i X_{ij}$ is the global expense of the importer j. Ω_i and Φ_j, the multilateral resistance terms[1], are included to avoid the "Gold medal error" (Baldwin & Taglioni, 2007). The literature generally relies on two measurement approaches. The first measure of multilateral resistance is what is technically called "Remoteness". The second approach recommends the use of fixed effects. In this paper, we use the Helliwell multilateral proxies (because they take into account the economic size of the countries), which we modify subsequently by giving them a bilateral dimension. Theses proxies are given in (2):

$$RM1_{in} = \frac{\sum_i Dist_{ij}}{Y_i} \qquad RM2_{in} = \left[\frac{\sum_i Y_i}{Dist_{ij}}\right]^{-1} \quad (2)$$

The two measures seem to be biased. The first gives particular importance to multilateral resistances in small countries because it grows exponentially when $Y_i \to 0$. The second tends to minimize multilateral resistance in small countries. Furthermore, due to the fact that our dependent variable is bilateral, we tried to give the bilateral measure of theses proxies as:

$$RM_{ij} = \left[\frac{Y_i}{Dist_{ij}}\right]^{-1} \quad (3)$$

The other empirical debate in the gravity equation is how to model the distance. Should the distance be international, intra-national or both? Generally, the measure adopted for international distance is that of an orthodromic distance between the two capitals of countries i and j. However, this measure is criticized, as the transport of goods does not follow a rectilinear trajectory. In this context, it is important, in order to reduce the potential related bias, to integrate intra-national distance. Following Wei (1996) and Wolf (1997), we adopt the measure given by Helliwell (1998), noted as the root square of the country area.

After integrating the resistance and the distance terms, our augmented and log-linearized gravity model can be noted as follows:

$$\begin{aligned} Log(X_{ijt}) = \beta_0 &+ \beta_1 Log(Y_{it}) + \beta_2 Log(Y_{jt}) + \beta_3 Log(Pop_{it}) + \beta_4 Log(Pop_{jt}) \\ &+ \beta_5 Log(Dist_{ij}) + \beta_6 Log(Dist\_Intra_i) + \beta_7 Log(Dist\_Intra_j) \\ &+ \beta_8 CFA_{ij} + \beta_9 Op_{ij} + \beta_{10} CL_{ij} + \beta_{11} CB_{ij} + \beta_{12} CC_{ij} + \beta_{13} RM_{i(n)(j)} \\ &+ \mu_{ij} + \varepsilon_{ijt} \end{aligned} \quad (4)$$

In this specification, X_{ijt} is the bilateral exports from country i to country j, $Y_{i(j)}$ the nominal GDP of country $i(j)$, $Pop_{i(j)}$ the population of country $i(j)$ and $Dist_{ij}$ the bilateral distance between countries i and j. $Dist\_Intra_{i(j)}$ captures the intra-national distance of county $i(j)$, measured as the square root of the area of the country.

[1] According to Head and Mayer (2013), $\Phi_j = \sum_l \frac{\phi_{jl} Y_l}{\Omega_l}$ and $\Omega_i = \sum_l \frac{\phi_{li} Y_l}{\Phi_l}$.

Among the dummy variables, CFA_{ij} is the variable for sharing the single currency, taking the value 1 if countries $i\ and$ j belong to the same zone, and 0 otherwise, and it is the variable of interest in this paper. It is used in three different specifications, one for CAEMC, one for WAEMU and the last one for the two zones taken together. Op_{ij} is the variable indicating the simultaneous openness of partners, equal to 1 if countries i and j are simultaneously open to the sea and 0 if not. CL_{ij} is equal to 1 if countries i and j share the same official language, and 0 otherwise. CC_{ij} is a dyadic which takes the value 1 if countries i and j have been colonized by the same metropolis. The variable $RM_{i(n)(j)}$ captures the bilateral resistances (RM_{ij}) and multilateral resistances (RM_{in}). Finally, μ_{ij} is the bilateral fixed effect and ε_{ijt} is a random perturbation; i the individual dimension (country) and t the temporal dimension.

3.2. Brief survey on estimation techniques

The estimation of gravity models faces several technical problems. As documented by Kabir, Salim and Al-Mawali (2017), these problems are related to (i) heteroscedasticity, heterogeneity and autocorrelation (Kabir, 2009), (ii) the management of zero trade value (Helpman Melitz & Rubinstein , 2008; Felbermayr Gabriel & Wilhelm, 2006; Harris Kónya & Mátyás, 2012; Magee, 2008; Westerlund & Wilhelmsson, 2009), (iii) the nature (fixed or random) of specific effects (Egger, 2002; Baier & Bergstrand, 2007), (iv) the presence of cross-sectional dependence (Breitung and Pesaran, 2008; Harris Kónya & Mátyás, 2012), (v) endogeneity and the double-hurdle (Harris Kónya & Mátyás, 2012), (vi) multicollinearity and identification (Cheong et al., 2015).

The debate on the gravity model literature revolves around the management of the problem of zero flows of the dependent variable, resulting in a loss of information. Indeed, taking the logarithm of trade flows in the presence of zero values, the matrix of these flows will be reduced to the positive values. To overcome this problem, the literature proposes approaches based on log-linear models (truncated OLS regression, panel fixed effects model, panel random effects model, Feasible Generalised Least Square Estimator – FGLS –, Eaton and Kortum – EK – Tobit Model) and those based on multiplicative models' estimators (Generalized linear models – GLM) such as the Poisson Pseudo Maximum Likelihood (PPML) Estimator and the Multinomial PPML.

However, the inability of log-linear specifications to efficiently handle the zero-value problem has shifted interest to non-linear specifications. For this purpose, Santos-Silva and Tenreyro (2006) propose a strategy to overcome the inconsistency occurring when the model is estimated by OLS using the log-linear functional form, in the presence of heterokedasticity and null trade flows. When the matrix of trade flows is sparse, the hypothesis of a log-normal error terms distribution of the log-linear model is violated. Santos-Silva and Tenreyro (2006) recommend the use of the Poisson Pseudo Maximum Likelihood (PPML) estimator.

To do this, model (4) becomes non-linear and specified as

$$X_{ijt} = \text{Exp}\begin{Bmatrix} \beta_0 + \beta_1 Log(Y_{it}) + \beta_2 Log(Y_{jt}) + \beta_3 Log(Pop_{it}) + \beta_4 Log(Pop_{jt}) \\ +\beta_5 Log(Dist_{ij}) + \beta_6 Log(Dist\_Intra_i) + \beta_7 Log(Dist\_Intra_j) \\ +\beta_8 CFA_{ij} + \beta_9 Op_{ij} + \beta_{10} CL_{ij} + \beta_{11} CB_{ij} + \beta_{12} CC_{ij} + \beta_{13} RM_{i(n)(j)} \end{Bmatrix} + \mu_{ij} + \varepsilon_{ijt} \quad (5)$$

3.3. Variables, sample and data source

The variables used in this paper are of two types, namely quantitative and dummy variables. A detailed presentation is given in appendix 1. The sample covers the CAEMC and WAEMU members countries (reporters countries), supplemented by their partners, grouped within the African sub-regions (ECOWAS, ECCAS, SADC, CAE, AMU) and other regions of the world (EU, ASEAN, MERCOSUR and NAFTA), for a total of 95 countries (see appendix 2). The period of study selected is 1995-2014, in order to guaranty a balanced sample according to the dependent variable, which is the total bilateral exports. We exclude Guinea-Bissau from the WAEMU group due to data unavailability on several variables, notably the dependent variable. The data are extracted from three main bases: the UNCTAD database for bilateral exports, the World Bank database (*World Development Indicators*) for quantitative variables and the CEPII base for distances.

4. RESULTS AND ROBUSTNESS

4.1. Results

Taking the sub-region specifications, the finding of the main variable of interest of this article (CFA_{ij}) seems to confirm the intuition. Indeed, the use of the CFA franc in the CAEMC and WAEMU seems to have fostered commercial integration in the two sub-regions. However, this effect is different. Specifically, the results show that bilateral trade would have increased (according to all specifications), on average by 55.44% in the CAEMC and by 38.56% in the WAEMU. This effect, which is significant at 1%, also hides a reality, namely a small proportion of intra-sub-regional trade flows in these two regions. Indeed, recent statistics show that intra-regional trade has not exceeded 2% for the CAEMC and 10% for the WAEMU (see Table 1). It is therefore a consistent increase, even if based on very small quantities.

The results of bilateral and multilateral resistances are globally negative in the CAEMC and positive in the WAEMU. This difference suggests the existence of variant and invariant factors, but not taken into account by the standard gravity model, which depress trade in the CAEMC, but tends to intensify it in the WAEMU. Indeed, this finding should not always be surprising, because the gravity equation fails to model factors such as political agreements and other factors related to bilateral partnerships agreements.

Moreover, the results generally remain in line with the theoretical predictions for the traditional variables, namely GDP, populations and distance, except in the WAEMU where the GDP of country i is negatively correlated with bilateral trade. This paradoxical result, observed whatever the specification, could be explained by the fact that any increase in production in this sub-region is not in favor of trade.

This result may be meaningful, given that most WAEMU member countries are specialized in the services and food products, because they do not have natural resource endowments and a fairly rich subsoil.

Table 1: Separated PPML results in CAEMC and WAEMU.

	Dependent variable: bilateral exports							
	CAEMC				WAEMU			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Log(Y_i)	0.1551***	0.0794***	0.1372***	0.1583***	-0.077***	-0.067***	-0.075***	-0.079***
	(15.68)	(5.51)	(11.29)	(16.05)	(3.56)	(2.87)	(3.39)	(3.67)
Log(Y_j)	0.2126***	0.2132***	0.2143***	0.2180***	0.1267***	0.1269***	0.1271***	0.1245***
	(96.69)	(96.76)	(96.97)	(92.02)	(70.85)	(70.94)	(71.00)	(66.15)
Log(Pop_i)	-0.709***	-0.502***	-0.665***	-0.778***	0.3076***	0.3227***	0.3160***	0.2995***
	(14.70)	(8.90)	(12.77)	(16.16)	(4.85)	(5.02)	(4.97)	(4.70)
Log(Pop_j)	0.0462***	0.0458***	0.0479***	0.1442***	0.0711***	0.0694***	0.0686***	0.1269***
	(16.15)	(15.98)	(16.67)	(34.07)	(30.53)	(29.52)	(29.13)	(40.96)
Log($Dist_{ij}$)	-0.262***	-0.262***	-0.244***	-0.259***	-0.312***	-0.329***	-0.336***	-0.267***
	(56.94)	(54.89)	(47.59)	(46.40)	(83.35)	(68.87)	(65.69)	(62.51)
XAF_{ij}	0.4419***	0.4418***	0.4446***	0.4363***				
	(30.00)	(29.98)	(30.10)	(23.23)				
XOF_{ij}					0.3913***	0.3874***	0.3854***	0.1404***
					(37.80)	(37.36)	(37.14)	(12.07)
$RM1_{in}$		-0.002***		-0.001***		-0.0007		0.0006
		(5.12)		(3.71)		(0.63)		(0.47)
$RM2_{in}$			-7.305***				6.3083***	
			(7.32)				(3.81)	
RM_{ij}		-0.0087	-0.0348**			0.2218***	0.0495	
		(0.48)	(2.50)			(5.52)	(0.87)	
Log(D_intra_i)				1.5200***				-0.0691
				(3.26)				(0.64)
Log(D_Intra_j)				-0.201***				-0.118***
				(36.27)				(29.25)
Op_{ij}				0.1648***				0.1824***
				(14.34)				(17.94)
CL_{ij}				0.1214***				0.0771***
				(11.82)				(7.55)
CB_{ij}				0.0592***				0.1052***
				(2.84)				(8.50)
CC_{ij}				0.4589***				0.3580***
				(34.50)				(30.06)
Constant	5.8138***	4.2573***	5.3292***	-3.7502	-2.671***	-3.008***	-2.669***	-2.739***
	(8.70)	(6.37)	(7.89)	(1.29)	(4.60)	(4.38)	(4.39)	(3.51)
Observations	11 238	11 238	11 238	11 238	13 111	13 111	13 111	13 111
μ_{ij}	Yes	No	No	Yes	Yes	No	No	Yes
Pairs	1 900	1 900	1 900	1 900	1 900	1 900	1 900	1 900
Alpha	0.6752	0.4326	0.6072	0.3761	0.0413	0.0414	0.0439	0.0205
lnalpha_cons	-0.3927	-0.8378	-0.4988	-0.9777*	-3.186***	-3.182***	-3.125***	-3.884***
	(0.74)	(1.50)	(0.92)	(1.77)	(5.93)	(5.92)	(5.83)	(7.24)
LR test $\alpha = 0$	5 081.07	5 000.18	4 694.04	2 035.27	2 203.05	1 854.25	1866.27	1 250.14
Pro>=chibar2	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Wald chi2	24242.56	24259.09	24219.72	27315.85	21144.26	21258.24	21275.95	24113.60
Prob > chi2	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]

z-stats in parentheses * p<0.10 ; ** p<0.05 ; *** p<0.01

Source: Author

In this context, any increase in production would be marginal and oriented towards local consumption. By adopting an income perspective in country j, it appears that if income increases in this country, this gives an additional purchasing power to the country, capable of increasing its domestic and foreign demand. However, the effect could be mitigated in country i since not all production is necessarily destined for export. There must be surpluses.

We estimate also the same equation for the two areas taken together. In this specification, we assume three scenarios: “Cooperation”, “Aggregation” and “Consolidation”.

In the first scenario (“Cooperation”), we include the single currencies as two different variables (XAF for CAEMU and XOF for WAEMU) in the same model. The two currencies coexist, but each zone retains its privileges: we are close to the theoretical status quo, since it is postulated that the effects of the CFA would be different. Some operating principles of the Franc Zone could be revisited. For example, it is possible to decide to pool foreign exchange reserves and create a common account of operations, but multilateral surveillance remains confined to the each zone. It is a non-voluntary integration scheme that is limited to the minimum. Here, we estimate a single model for both Communities, with XAF and XOF being treated as two separate but juxtaposed variables (see Eq. 6):

$$X_{ijt} = Exp\left\{\begin{array}{l}\beta_0 + \beta_1 Log(Y_{it}) + \beta_2 Log(Y_{jt}) + \beta_3 Log(Pop_{it}) + \beta_4 Log(Pop_{jt}) \\ +\beta_5 Log(Dist_{ij}) + \beta_6 Log(Dist\_Intra_i) + \beta_7 Log(Dist\_Intra_j) \\ +\beta_8 XAF_{ij} + \beta_9 XOF_{ij} + \beta_{10} RM_{i(n)(j)} + \theta D_{ij}\end{array}\right\} + \mu_{ij} + \varepsilon_{ijt} \quad (6)$$

D_{ij} is the vector for dummy variables and θ the vector of their coefficients.

In the second scenario (“Aggregation”), we assume the aggregation of the single currencies into a single variable. Both CFAs are supposed to have the same effect, but each zone keeps its currency. This is the hypothesis of the superposition or indifference of CFA in CAEMU and WAEMU. The two central banks coexist. This scenario is based on the psychology of actors and citizens, especially with regard to the belief that they have in both currencies, even if the institutional mechanisms are slow to adjust. Here, the populations and the economic operators apprehend the CFAs indifferently, which is quite the opposite of the institutional ones who are not compatible with necessary reforms. We estimate a single model for both Communities, XAF and XOF being stacked as one variable:

$$X_{ijt} = Exp\left\{\begin{array}{l}\beta_0 + \beta_1 Log(Y_{it}) + \beta_2 Log(Y_{jt}) + \beta_3 Log(Pop_{it}) + \beta_4 Log(Pop_{jt}) \\ +\beta_5 Log(Dist_{ij}) + \beta_6 Log(Dist\_Intra_i) + \beta_7 Log(Dist\_Intra_j) \\ +\beta_8 XAFXOF_{ij} + \beta_9 RM_{i(n)(j)} + \theta D_{ij}\end{array}\right\} + \mu_{ij} + \varepsilon_{ijt} \quad (7)$$

The third scenario (“Consolidation”) postulates the transition to an enlarged and consolidated monetary union for both. Here we postulate the fusion of the two communities. The XAF and the XOF merge to become one and the same currency (called CFA) circulating in all 14 countries of the AFZ. Gradually, CAEMU and WAEMU merge to create a new entity governed by new principles. The single currency is managed by a new Central Bank (BEAC and BCEAO merge) and foreign exchange reserves are further consolidated. Under this scenario, cooperation in the ZFA becomes total.

Both zones reinvent themselves, but choose the internal opening. This is a more optimistic scenario than that of cooperation or aggregation. In the estimated model, the CFA variable is reconstructed assuming that the two zones form a single currency union. $CFA_{ij} = 1$ if the country pair (i, j) belongs to the AFZ. This scenario is modelled as (see Eq. 8):

Table 2: PPML estimator Results for the two zones under three scenarios.

	Dependent variable: bilateral exports					
	Cooperation scenario		Aggregation scenario		Consolidation scenario	
	[9]	[10]	[11]	[12]	[13]	[14]
$Log(Y_i)$	0.0207*	0.0706***	0.0207*	0.0704***	0.0191*	0.0721***
	(1.86)	(7.27)	(1.86)	(7.26)	(1.71)	(7.46)
$Log(Y_j)$	0.1645***	0.1642***	0.1646***	0.1643***	0.1707***	0.1704***
	(112.34)	(112.11)	(112.69)	(112.46)	(115.54)	(115.28)
$Log(Pop_i)$	-0.1599***	-0.2650***	-0.1599***	-0.2646***	-0.1747***	-0.2865***
	(4.59)	(8.03)	(4.59)	(8.02)	(5.01)	(8.71)
$Log(Pop_j)$	0.1250***	0.1267***	0.1245***	0.1263***	0.1239***	0.1258***
	(49.86)	(50.27)	(50.46)	(50.90)	(50.14)	(50.62)
$Log(Dist_{ij})$	-0.2482***	-0.2373***	-0.2480***	-0.2372***	-0.2299***	-0.2183***
	(68.54)	(58.37)	(68.55)	(58.37)	(62.05)	(52.52)
XAF_{ij} (cooperation)	0.2546***	0.2524***				
	(17.32)	(17.17)				
XOF_{ij} (cooperation)	0.2371***	0.2374***				
	(21.87)	(21.88)				
XAF_{ij} and XOF_{ij} (aggregation)			0.2426***	0.2421***		
			(25.34)	(25.27)		
CFA_{ij} (consolidation)					0.3075***	0.3067***
					(39.55)	(39.42)
$RM1_{ij}$	-0.0022***		-0.0022***		-0.0023***	
	(7.71)		(7.69)		(8.08)	
$RM2_{ij}$		-1.2910*		-1.2852*		-1.4340**
		(1.67)		(1.66)		(1.86)
RM_{ij}	0.0086	-0.0665***	0.0081	-0.0668***	0.0150	-0.0623***
	(0.53)	(5.07)	(0.50)	(5.09)	(0.93)	(4.77)
$Log(D\_intra_i)$	0.2373	0.3179*	0.2374	0.3178*	0.2525	0.3364*
	(1.49)	(1.65)	(1.49)	(1.66)	(1.53)	(1.67)
$Log(D\_Intra_j)$	-0.141***	-0.142***	-0.140***	-0.141***	-0.143***	-0.145***
	(43.27)	(43.57)	(43.70)	(44.03)	(44.83)	(45.18)
Op_{ij}	0.1823***	0.1832***	0.1825***	0.1833***	0.1909***	0.1918***
	(24.08)	(24.20)	(24.11)	(24.23)	(25.24)	(25.35)
CL_{ij}	0.0882***	0.0881***	0.0890***	0.0888***	0.0660***	0.0658***
	(12.29)	(12.28)	(12.47)	(12.45)	(9.18)	(9.16)
CB_j	0.1288***	0.1389***	0.1304***	0.1402***	0.1926***	0.2029***
	(12.07)	(12.89)	(12.33)	(13.12)	(19.71)	(20.52)
CC_{ij}	0.4022***	0.4017***	0.4002***	0.4000***	0.3511***	0.3510***
	(46.51)	(46.46)	(47.39)	(47.38)	(40.96)	(40.95)
Constant	-0.5810	-0.6573	-0.5826	-0.6591	-0.6982	-0.7625
	(0.58)	(0.54)	(0.58)	(0.54)	(0.66)	(0.59)
Observations	24 349	24 349	24 349	24 349	24 349	24 349
Pairs	1 900	1 900	1 900	1 900	1 900	1 900
Alpha	0.0835	0.1216	0.0833	0.1212	0.0902	0.1331
lnalpha_cons	-2.481***	-2.106***	-2.485***	-2.109***	-2.404***	-2.016***
	(6.05)	(5.25)	(6.05)	(5.26)	(5.88)	(5.05)
LR test $\alpha = 0$	3 698.28	3 641.33	3 703.88	3 648.06	3 798.33	3 745.22
Prob>=chibar2	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Wald chi2	49 210.79	49 124.32	49 224.18	49 135.70	49 575.29	49 491.55
Prob > chi2	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
	z-stats in parentheses		* p<0.10 ; ** p<0.05 ; *** p<0.01			

Source: Author.

$$X_{ijt} = Exp\left\{\begin{array}{l}\beta_0 + \beta_1 Log(Y_{it}) + \beta_2 Log(Y_{jt}) + \beta_3 Log(Pop_{it}) + \beta_4 Log(Pop_{jt}) \\ +\beta_5 Log(Dist_{ij}) + \beta_6 Log(Dist\_Intra_i) + \beta_7 Log(Dist\_Intra_j) \\ +\beta_8 CFA_{ij} + \beta_9 RM_{i(n)(j)} + \theta D_{ij}\end{array}\right\} + \mu_{ij} + \varepsilon_{ijt} \quad (8)$$

The results of these different scenarios reported in Table 2 show that treating CAEMC and WAEMU as a consolidated monetary union is beneficial for both. Indeed, the multiplier effect on trade would be positive, from 26.77% to 27.42%.

4.2. Robustness checks

In order to validate our results, we test the robustness of the estimated coefficients, in particular that associated to our main variable of interest, namely the sharing of a single currency. To do this, we re-estimate our gravity model by using four competing estimators to PPML: (i) the ordinary least squares (OLS) estimator, because of the near similarity of its first order conditions with those of the PPML combined to the absence of heteroskedasticity assumption (Head & Mayer, 2014); (ii) the GAMMA-PML estimator, accounting for the fact that the conditional variance could be a function of higher power of the conditional mean (Santos Silva & Tenreyro, 2006; Head & Mayer, 2014); (iii) the Zero-Inflated Poisson (ZIP) estimator, for the control of a possible bias relative to the high proportion of zero in the dependent variable (De Benedictis & Taglioni, 2011). More specially, ZIP is used when the dependent variable is non-negative count data. It is a model that simulates the number of occurrences of an event and is suitable when the number of observed zero values exceeds the number of zeros predicted by the other methods (Burger, Van Oort & Linders, 2009); (iv) the Negative Binomial (NEGBIN) estimator, for the control of a possible bias related to the "over-dispersion" (the PPML requires the “equi-dispersion” property) of the dependent variable (De Benedictis & Taglioni, 2011). NEGBIN is used for non-negative count data. Here, the count variable is generated by a "pseudo" Poisson's distribution, provided that its variance is greater than that of the "true" Poisson's law. We speak of over-dispersion

The results of this robustness test (Table 3) show that the effect of the variables of interest retains the same sign; a positive and significant effect at 1% of sharing a common currency on bilateral trade. However, this effect appears to be overestimated by the OLS specification and underestimated by the GAMMA specification.

Table 3: Robustness checks.

Dependent variable: bilateral exports

	CAEMC				WAEMU				CAEMU + WAEMU			
	OLS	GAMMA	ZIP	NEGBIN	OLS	GAMMA	ZIP	NEGBIN	OLS	GAMMA	ZIP	NEGBIN
$Log(Y_i)$	1.1504***	0.0551***	0.0567***	0.2213***	2.6512***	0.1003***	0.1215***	0.3212***	1.1851***	0.0598***	0.0625***	0.1711***
	(23.81)	(23.88)	(21.99)	(22.44)	(29.54)	(24.35)	(30.10)	(24.02)	(30.57)	(36.62)	(33.06)	(25.94)
$Log(Y_j)$	1.6572***	0.0470***	0.0569***	0.2251***	1.1649***	0.0311***	0.0383***	0.1351***	1.5073***	0.0400***	0.0492***	0.1953***
	(48.85)	(31.09)	(32.84)	(35.55)	(46.23)	(27.44)	(33.80)	(34.80)	(74.43)	(42.21)	(49.65)	(52.96)
$Log(POP_i)$	0.5886***	-0.0143***	0.0032	0.0856***	-2.3382***	-0.0775***	-0.106***	-0.3177***	0.7889***	-0.0079***	0.0080***	0.1254***
	(11.80)	(7.35)	(1.24)	(9.15)	(12.77)	(9.92)	(13.15)	(11.61)	(19.92)	(4.59)	(3.76)	(18.54)
$Log(POP_j)$	0.4321***	0.0121***	0.0252***	0.1016***	0.7474***	0.0191***	0.0261***	0.1017***	0.5178***	0.0159***	0.0238***	0.0803***
	(10.02)	(5.93)	(10.95)	(12.05)	(21.35)	(12.88)	(16.16)	(18.23)	(18.82)	(13.06)	(17.47)	(16.89)
$Log(Dist_{ij})$	-2.1973***	-0.0478***	-0.074***	-0.0001***	-3.2309***	-0.0648***	-0.092***	-0.3964***	-2.5352***	-0.0675***	-0.089***	-0.3666***
	(16.98)	(11.86)	(15.18)	(21.17)	(48.72)	(25.36)	(34.78)	(35.87)	(36.62)	(32.19)	(34.43)	(37.39)
CFA_CAEMC	3.0863***	0.1192***	0.1660***	0.6060***								
	(10.05)	(14.72)	(16.28)	(17.46)								
CFA_WAEMU					3.9804***	0.1432***	0.1755***	0.3743***				
					(25.06)	(26.97)	(29.74)	(19.56)				
$CFA\_Consolidation$									3.7598***	0.0939***	0.1196***	0.4690***
									(29.59)	(22.16)	(23.10)	(28.03)
Constant	-55.1802***	0.6861***	0.0339	-10.972***	-25.069***	1.1304***	0.9620***	-1.4769***	-53.882***	0.7579***	0.1742***	-6.7512***
	(40.26)	(10.30)	(0.49)	(38.47)	(13.09)	(17.95)	(12.63)	(5.50)	(56.24)	(17.20)	(3.76)	(37.31)
Observations	11 238	6 965	11 238	11 238	13 111	9 653	13 111	13 111	24 349	16 618	24 349	24 349
Pairs	1 900	1 900	1 900	1 900	1 900	1 900	1 900	1 900	1 900	1 900	1 900	1 900
R2	0.4133				0.4072				0.4059			
Fisher	2 046.70				2 087.22				3 952.77	4 733.71		
Prob > F	[0.0000]				[0.0000]				[0.0000]	[0.0000]		
Wald chi2		2 903.42	3 910.28	2 825.06		2 607.41	6 259.61	3 359.92			8 096.12	6 054.43
Prob > chi2		[0.0000]	[0.0000]	[0.0000]		[0.0000]	[0.0000]	[0.0000]			[0.0000]	[0.0000]

Note : * p<0,10 ; ** p<0,05 ; *** p<0,01

Source : Author.

5. CONCLUDING REMARKS

The objective of this article was to evaluate the CFA franc effect on market integration in the African Franc Zone member countries. To achieve this, we used a gravity model according to the latest developments of Head and Mayer (2014), augmented with bilateral (and multilateral) resistances to address the gold medal error, a dummy variable capturing the sharing of a single currency and several other control variables. Following a series of empirical manipulations using the PPML estimator as the main technique, we obtain the following key findings: (*i*) the effect of CFA on the bilateral trade of the African Franc Zone member countries is positive, but different in the two zones, because of the specific characteristics of the countries; (*ii*) based on three modeled scenarios ("Aggregation", "Cooperation" and "Consolidation"), the results finally show that the two zones would all win if they merged to form a consolidated monetary union, which would tend to justify the ongoing reforms.

In the light of these results, it seems appropriate for the authorities to reflect deeply on the reform of the African franc zone which could restore the role of the shared currency as a real instrument of macroeconomic adjustment. These reforms could move towards the consolidation of the two zones into a single monetary union or towards the opening of the member countries to the regional economic communities established by the African Union strategy, as actually in WEAMU with the ECO.

This paper could thus presented as a relevant empirical basis which can shed light on the decision of WAEMU countries to switch from the CFA Franc to the ECO, just as it can be used as a reference to guide the rational that would currently be carried out in the CEMAC area.

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APPENDIX

Appendix 1: Description of the variables used.

Variable	Description	Source	Groups					
			CAEMC		WAEMU		CAEMC + WAEMU	
			Mean (obs.)	Std-dev.	Mean (obs.)	Std-dev.	Mean (obs.)	Std-dev.
X_{ijt}	Dependent variable that measures bilateral exports from country i to country j.	UN CTAD (2016)	8.3091 (11 400)	7.1392	9.9905 (13 300)	6.6581	9.2145 (24 700)	6.9350
Y_{it}	Nominal GDP of country i, ie the reporter country.	World Bank (WDI)	22.3180 (11 400)	1.1542	22.4009 (13 300)	0.7871	22.3626 (24 700)	0.9747
Y_{jt}	Nominal GDP of country j, ie the partner country or country of destination.		24.2100 (11 238)	2.4167	24.2114 (13 111)	2.4181	24.2108 (24 349)	2.4174
Pop_{it}	Population of country i, that is, the reporter country.		15.0864 (11 400)	1.1417	16.2167 (13 300)	0.3990	15.6950 (24 700)	1.0024
Pop_{jt}	Population of country j, ie partner country.		16.1515 (11 400)	1.1417	16.0911 (13 300)	1.7395	16.1190 (24 700)	1.7233
$Dist_{ij}$	Distance between country i and country j. It is measured in kilometers.	CEPII	8.3034 (11 400)	0.7631	8.3127 (13 300)	0.7980	8.3084 (24 700)	0.7821
$Dist\_Intra$	Intra-national distance of country i, measured as the logarithm of the square root of the area of the country.	Author, using World Bank (WDI)	6.3301 (11 400)	0.5948	6.2911 (13 300)	0.5334	6.3091 (24 700)	0.5629
$Dist\_Intra$	Intra-national distance of country j, measured as the logarithm of the square root of the area of the country.		6.0368 (11 400)	1.0502	6.0420 (13 300)	1.0453	6.0396 (24 700)	1.0475
$RM1_{in}$	Multilateral resistance according to Helliwel first specification (1998) : $RM1_{in} = \frac{\sum_i Dist_{ij}}{Y_i}$		0.0002 (11 400)	0.0003	0.0001 (13 300)	0.0001	0.0002 (24 700)	0.0003
$RM2_{in}$	Multilateral resistance according to Helliwel second specification (1998) : $RM2_{in} = \left[\frac{\sum_i Y_i}{Dist_{ij}}\right]^{-1}$		5.48e-08 (11 400)	7.22e-08	5.18e-08 (13 300)	4.93e-08	5.32e-08 (24 700)	6.10e-08
RM_{ij}	Bilateral resistance between country i and any country j. It is measured as the report $Dist_{ij}/PIB_i$.		2.20e-06 (11 400)	5.04e-06	1.28e-06 (13 300)	1.36e-06	1.70e-06 (24 700)	3.59e-06
MU_{ij}	Simulated dummy variable for sharing a single currency between country i and country j.	Author, using Google Earth data	//	//	//	//	//	//
Op_{ij}, CB_{ij}, CL_{ij}, CC_{ij}	Dummy variable of the simultaneous opening to the sea, sharing of a common land border, sharing a common language, sharing a common colizer in the past		//	//	//	//	//	//

Source: Author.

Appendix 2 : The sample.

ECCAS	ECOWAS	SADC without Angola, RDC and Tanzanie	UMA + Egypt	EAC without Burundi	EU of 28	ASEAN + Japon + China + South Corea	MERCOSUR	NAFTA
Angola	Benin*	Botswana	Algeria	Kenya	Austria	Brunei Darussalam	Argentina	Canada
Burundi	Burkina Faso*	Lesotho	Libya	Rwanda	Belgium	Cambodge	Brasil	Mexico
Cameroon*	Cape Verde	Madagascar	Mauritania	Uganda	Bulgaria	China	Paraguay	United States
Centrafrique*	Côte d'Ivoire*	Malawi	Morocco	Tanzania	Croatia	Indonésia	Uruguay	
Chad*	Gambia	Mauricius	Tunisia		Cyprus	Japon	Venezuela	
Congo*	Ghana	Mozambique	Egypt		Czech republic	Corea, Republique of		
DR Congo	Guinea	Namibia			Denmark	Dem. Rep. of Lao		
Equatorial Guinea *	Guinea-Bissau	Seychelles			Estonia	Malaisia		
Gabon*	Liberia	South Africa			Finlande	Myanmar		
Sao Tomé-and-Principe	Mali*	Swaziland			France	Philippines		
	Niger*	Zambia			Germany	Singapour		
	Nigeria	Zimbabwe			Greece	Thaïlande		
	Senegal*				Hungary	Viet Nam		
	Sierra Leone				Irland			
	Togo*				Italy			
					Lettonia			
					Lituania			
					Luxembourg			
					Malte			
					Netherland			
					Poland			
					Portugal			
					Roumania			
					Slovakia			
					Slovenia			
					Spain			
					Sweden			
					United Kingdom			

Note : * = CAEMC and WAEMU countries (*reporters countries*)

Source: Author.

L'effet du Franc CFA sur le commerce

Résumé - L'*objectif de cet article est d'évaluer, à la lumière de la thèse endogène des zones monétaires optimales, l'effet du partage du franc CFA par les pays de la Zone Franc africaine sur leur commerce bilatéral depuis 1995. L'évaluation est faite à partir d'un modèle de gravité augmenté estimé selon la méthode du Pseudo-Maximum de Vraisemblance. Au terme des analyses, nous parvenons à deux principaux résultats : (i) premièrement, l'effet du franc CFA sur le commerce bilatéral des pays de la Zone Franc africaine est positif, mais différent selon les zones, à cause des caractéristiques des pays ; (ii), sur la base de trois scénarii modélisés (« Agrégation », « Coopération » et « Consolidation »), les résultats montrent enfin que les deux zones gagneraient toutes si elles fusionnaient pour former une union monétaire consolidée, ce qui tendrait à justifier les réformes en cours.*

Mots-Clés

Zone Franc africaine
Franc CFA
Commerce bilatéral
Modèle de gravité