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Currency Substitution and Monetary Policy Effectiveness in the African Franc Zone: The Case of CEMAC

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Abstract: *In an environment marked by persistent financial instability, the need for private agents to diversify their portfolios has revived analyses of the effectiveness of monetary policy in the presence of currency substitution (Colacelli and Blackburn, 2007; Grupta, 2008; Kaplan, Kalyoncu, and Yucel, 2008; Asel, 2009; Milenkovic and Davidovic, 2013).*

The present study has attempted, using a money demand function plus a currency substitution indicator, to show that currency substitution exists in different forms and for different reasons in the CEMAC zone.

Keywords*: Currency substitution, bank credit channel, risk-taking channel, financial stability*.

Résumé

Dans un environnement marqué par l'instabilité financière persistante, la nécessité pour les agents privés de diversifier leur portefeuille a remis au goût du jour les analyses relatives à l'efficacité de la politique monétaire en présence de la substitution des monnaies (Colacelli et Blackburn, 2007 ; Grupta, 2008 ; Kaplan, Kalyoncu et Yucel, 2008 ; Asel, 2009 ; Milenkovic et Davidovic, 2013).
La présente réflexion s'est attelée, à partir d'une fonction de demande de monnaie augmentée d'un indicateur de substitution des monnaies, à montrer que la substitution des monnaies existe sous différentes formes et pour différentes raisons en zone CEMAC.

Mots clés : Substitution des monnaies, canal du crédit bancaire, canal de la prise de risque, stabilité financière.

Code JEL : E52, E41

I. Introduction

In an environment marked by persistent financial instability, the need for private agents to diversify their portfolios has revived analyses of the effectiveness of monetary policy in the presence of currency substitution (Colacelli and Blackburn, 2007; Grupta, 2008; Kaplan, Kalyoncu, and Yucel, 2008; Asel, 2009; Milenkovic and Davidovic, 2013).
Thus, currency substitution characterizes the fact that a currency is used by the residents of a given country in place of the national currency (Hayek, 1976; Woodford, 1990; Guidotti and Rodriguez, 1992). Two types of currency substitution can then be distinguished (Brand, 1994): direct substitution, on the one hand, and indirect substitution, on the other.
Determined by institutional factors (Cagan, 1956; Ramirez-Rojas, 1985; Domowitz and Elbadawi, 1987; Frenkel, 1976), direct substitution exists when one or more currencies are legal tender in the same geographical space (Ramirez-Rojas, 1985; Domowitz and Elbadawi, 1987). Indirect substitution, on the other hand, corresponds to the situation where one or more international currencies (a basket of currencies) replaces the national currency in its three traditional functions (store of value, unit of account and means of payment) (McKinnon, 1982, 1985, 1996; Calvo and Vegh, 1992). This is precisely a strategy of diversification of the

portfolio of financial assets by economic agents (residents and non-residents) determined, among other things, by total financial liberalization of capital markets (McKinnon, 1982,1985, 1996; Calvo and Vegh, 1992).

The significance of the phenomenon of currency substitution differs between advanced and developing economies. In advanced economies, currency substitution is essentially the result of diversification of asset portfolios, on the one hand, and a high degree of integration into international trade, on the other. In developing economies, on the other hand, currency substitution in developing economies mainly reflects the detour of economic agents away from the domestic currency. Thus, in most developing countries, especially those experiencing an environment of great uncertainty (high inflation, financial fragility, inefficiency or non-existence of capital markets), the degree of currency substitution is generally high (Dontsi Dontsi, 2001 and Adom, Sharma and Mahbub Morshed, 2007).

Overall, much of the analysis of the link between currency substitution and the effectiveness of monetary policy revolves around two axes:

1°) that which analyzes the dynamics of the exchange rate in an environment of uncertainty ;

2°) that which determines an increased money demand function in a situation of persistent financial instability.

The dynamics of the exchange rate in an uncertain environment are generally assessed under the dual dimension of strategies for diversifying the portfolio of financial assets by economic agents (residents and non-residents) and for determining the household demand function. The dimension relating to financial asset portfolio diversification strategies reflects the need for economic agents to hedge against the risks of depreciation of the national currency in an environment of uncertainty (McKinnon, 1982, 1996; Cuddington, 1989 and Calvo and Vegh, 1992; Choudhry, 1998).

The determination of a demand function reflects the dynamics of consumption behaviour, due to the appreciation of households' preferences and the structure of their financial wealth in an environment marked by persistent instability (McKinnon, 1982, 1996; Cuddington, 1989 and Calvo and Vegh, 1992; Choudhry, 1998). Most of the work on this subject is aimed at defining an appropriate monetary policy strategy, leading to the identification of two modes of currency substitution :

- symmetrical currency substitution (mainly in advanced economies), in which residents' holdings of foreign currency are offset by foreign holdings of domestic currency (McKinnon, 1982, 1996 and Calvo and Vegh, 1992);

- Asymmetric currency substitution, most often in developing economies, whereby residents' holdings of a currency (or currencies) occur without any non-resident holding a domestic currency (Ramirez-Rojas, 1985 and Calvo and Vegh, 1992). In other words, the fact that economic agents (residents and non-residents) turn away from the national currency in favour of foreign currency in the presence of an environment of uncertainty (Dontsi Dontsi, 2001).

Determining a money demand function augmented by a currency substitution indicator ensures stable money demand in an unstable financial environment. To this end, most analyses are distinguished by a specific approach to the money demand function, notably the Cambridge-type approach on the one hand, and the Cagan-type approach (1956) on the other.

When the money-demand function approach is Cambridge-type, the existence of a high degree of currency substitution determines the choice of an exchange rate regime (Adom, Sharma and Mahbub Morshed, 2007) and the definition of an optimal monetary policy (Elkhafif, 2002; Yildirim, 2003). The Cagan (1956)-type money demand function approach, on the other hand, determines a degree of currency substitution in the presence of a hyperinflation environment (Choudhry, 1998; Engsted, 1998; Mladenovic and Petrovic, 2010).

The present study, which characterizes currency substitution by the fact that an economic agent substitutes currencies for the national currency to carry out its transactions, focuses on the African franc zone and specifically on the Economic and Monetary Community of Central Africa (CEMAC). Two reasons justify such a choice:

1°) the conduct of monetary policy takes place in an environment of great uncertainty. Therefore, the Bank of Central African States (BEAC), the common bank of CEMAC member countries, should pay greater attention to the currency substitution that is developing and its effects on the effectiveness of its monetary policy;

2°) Consisting essentially of debt economies, the CEMAC zone has a poorly developed financial system.

Consequently, the purpose of this study is to analyze currency substitution in CEMAC countries on the basis of an increased money demand function in order to assess its effects on the effectiveness of the monetary policy implemented in this zone.

Our analysis is therefore based on two main lines of inquiry: highlighting currency substitution in CEMAC (I), and analyzing currency substitution and its effect on the effectiveness of monetary policy (II).

I- Highlighting the substitution of currencies in the CEMAC zone

We use a model whose purpose is to check whether economic agents are turning away from the national currency in favour of foreign currencies.
To this end, we will first present the analytical framework and the articulation of the model before proceeding to its estimation.

1.1- The analytical framework and articulation of the model

The theoretical framework favoured here is the augmented New Keynesian economy of the credit market, which allows for a better account of imperfections in the supply and demand for credit emanating from both financial agents (credit supply, especially secondary banks) and non-financial agents (credit demand, especially households and firms) (Gertler and Kiyotaki, 2010, 2015; Gertler et al., 2012; Curdia and Woodford, 2016 and Hun Shim, 2017).
We start from the model of Adom et al. (2007), which analyzes different forms of currency substitution through a money demand function augmented by an indicator of currency substitution. More precisely, it is a demand for money that favours the transactions motive as the main motive for holding money by economic agents, whose advantage is to carry out transactions without transformation costs. The opportunity cost is the return on alternative financial assets that they give up.
The increased money demand function that we postulate depends on a variable representing transactions (real and financial) on the one hand, and a vector of opportunity cost variables on the other. It is presented as follows:

$$\frac{M}{P} = KY^{\delta}\exp(nr^{\alpha}), \qquad [1]$$

with : $\frac{M}{P}$, the amount of actual cash balances ; Y, the volume of transactions (real and financial) ;
r^{α}, the expected return on alternative assets to money ; $K, \delta \; and \; n$, the parameters.

The explained variable of the model is the money supply, broadly defined, which is the monetary aggregate monitored by the BEAC for the conduct of the common monetary policy of the CEMAC zone.
The explanatory variables are :
1°) the volume of real and financial transactions, measured by real Gross Domestic Product (GDP). The parameter, which corresponds to the elasticity of demand for real balances, should be positive, which means that the demand for money by economic agents does not include their financial wealth when the value of this elasticity is greater than one, in line with the situation of developing economies. Currency substitution then arises from the opportunity cost of residents' preference for foreign currency over domestic currency. It is therefore appropriate to determine its price as well as that of the domestic currency (Bordo and Choudhri, 1982).
Two types of substitution can be distinguished in the case of CEMAC:
- that between foreign and domestic currency;
- that between durable goods and domestic currency.
Currency substitution in CEMAC is essentially due to the effects of the globalization of trade induced by the dynamics of trade liberalization, on the one hand, and financial liberalization, on the other;
2°) the interest rate on deposits, which is the yield on the monetary aggregate (M2) ;
3°) the expected rate of inflation, which is the price of durable goods. In the present work, we postulate that expectations are adaptive (Friedman, 1956), which can be translated into the following relationship :

$$\pi_t^a = \theta\pi_{t-1} + (1+\theta)\pi_{t-1}^a, \qquad [2]$$

where :
π_t^a is the expected inflation rate at period t ;
π_{t-1} is the inertial inflation. $\theta \in [0,1]$. In the case where $\theta = 1$, then $\pi_t^a = \pi_{t-1}$, which means that inflation expectations are determined by the inertial inflation rate.
The expected rate of inflation is measured by the annual change in the Consumer Price Index (CPI) ;
4°) the anticipated real exchange rate is the indicator of currency substitution. More precisely, it is the expected real effective exchange rate, which reflects the multilateral nature of each member country's foreign trade.
We consider the following variables as other determinants of money demand: the corruption index, external debt service, the current account approximated by the trade balance, public debt and the net capital account.

The model for estimation purposes then takes the following linear form :

$$\left(\frac{M}{P}\right)_t^D = \alpha_0 + \alpha_1 tcera_t + \alpha_j X_t + \varepsilon_t, \qquad [3]$$

with : $X_t = (\inf la, y, g, gouv, cor, bc, sdext, ckn, dep)$, the vector of the other determinants of the money demand function.

$\left(\frac{M}{P}\right)_t^D$ The demand for actual cash at period t ;

$tcera_t$ the anticipated change in the exchange rate in period t ;

$\alpha_j (j = 1 \ldots \ldots 9)$ the coefficients of the other determinants of the money demand function;

α_0 the constant ;

ε_t the error term at period t.

Relationship [3] excludes the foreign interest rate as a determinant of the money demand function, thus avoiding the problem of collinearity.

The presence of the expected exchange rate makes it possible to identify the existence of currency substitution in an economy.

The parameter , which is the coefficient of the expected exchange rate, can be negative or positive. According to Bordo and Choudhri (1982), a negative sign reveals the existence of currency substitution, which implies that economic agents demand less national currency and more foreign currency. A positive sign, on the other hand, reflects the fact that economic agents demand more national currency and less foreign currency.

1.2- Model estimation and presentation of results

The model is based on a central assumption: economic agents turn away from the common currency in favour of currencies in an environment of uncertainty, which would mean that the use of a money demand function plus an indicator of currency substitution improves the effectiveness of monetary policy.

The initial data are annual and come from financial statistics published by the International Monetary Fund (IMF). For the estimation and to have the short frequency data, we had to quarterlyize them using the interpolation method of Goldstein and Khan (1976).

In what follows, we present the main tests used (unit root and cointegration tests) to highlight the relevant money demand function.

Indeed, the analysis of the dynamics of the variables requires first determining the order of integration of each of the variables in the model using the unit root test. The results of the Augmented Dickey Fuller test (ADF test) indicate that all the variables of the model are integrated in order 1 (Appendix 1). Such an analysis then requires identifying the number of cointegration vectors using a cointegration test by Johansen (1988) whose results confirm the existence of at least one cointegration vector between the explained variable and the explanatory variables of the model (Appendix 2).

The results also indicate that the recall force of each member country is negative and statistically significant, which means that the error-correction mechanism is satisfactory.

The estimation results are presented in the tables in Appendix 3, for the short term and the long term respectively in the appendix.

In the short term, the results reveal an overall lack of currency substitution in CEMAC. Economic agents in member countries do not turn away from the CFA franc, the common currency, contrary to the working hypothesis adopted. The expected real effective exchange rate has no statistically significant effect on money demand. In the long run, it appears that economic agents do indeed turn away from the CFA franc in favor of foreign currencies.

The results also reveal a heterogeneity in the levels of currency substitution. There are three categories of member countries:

1°) countries with a high degree of currency substitution (Congo and Chad). For Congo (-49.63) and Chad (-10.37), the expected real effective exchange rate has a negative and statistically significant impact on economic agents' demand for money respectively, which is similar to the result obtained by Adom et al. (2007).

The high degree of currency substitution due to proximity to the Democratic Republic of Congo, Angola, Nigeria and Sudan, which are influenced by dollarization ;

2°) countries with an average degree of currency substitution (Cameroon and Gabon). In Cameroon, the anticipated real effective exchange rate has a negative (-0.51) and significant impact on the increased demand

for currency. In Gabon, the anticipated real effective exchange rate has a negative (-2.27) and significant impact on the demand for money, increased by an indicator of currency substitution;
3°) the country (the Central African Republic) where there is no currency substitution. The anticipated real effective exchange rate acts precisely with a positive (0.84), albeit statistically significant, impact.
Inflation affects the money demand function plus an indicator of currency substitution, with a positive impact in the Central African Republic (0.48) and Chad (3.91), on the one hand, and a negative impact in the Congo (-42.34), on the other hand, which is statistically significant. Economic growth has a statistically significant (-8.78) effect on the money demand function only in the case of the Central African Republic.
We now propose to carry out an analysis of currency substitution and its effects on the effectiveness of monetary policy.

II. Analysis of currency substitution and its effects on the effectiveness Of monetary policy in the CEMAC zone

The results of the estimate reveal an overall change in currency substitution from short to long term in the CEMAC zone. Thus, the heterogeneity and the environment of uncertainty, which characterize such a zone, explain the different bases of currency substitution, the consideration of which would undoubtedly improve the effectiveness of monetary policy.

2.1- Foundations of currency substitution

We will take into account two types of factors, financial and non-financial, which are at the origin of the substitution of currencies by economic agents.
The financial factors stem in particular from the absence of a financial market and low real interest rates.
The absence of a financial market in the CEMAC zone limits the possibilities for diversifying the portfolios of economic agents in each member country and at the community level. Economic agents only have a choice between liquid assets and real assets whose returns are usually low. Therefore, in order to further diversify their financial assets, they turn to the search for financial assets in developed countries. This absence also amplifies the substitution behavior of currencies because of the low development of payment instruments in CEMAC.
The stylized facts relating to changes in the financial system confirm the growing trend in the use of financial services linked to new information and communication technologies (Beck et al., 2000, 2010; Beck and Cull, 2014; Guérineau and Jacolin, 2014; Bertho, 2014; Granata et al., 2014 and Allen et al., 2015). However, the share of new payment instruments in financial transactions remains low in the CEMAC zone (Annex 5).
As for low real interest rates, this is due to their role as the main determinant of capital movement dynamics. In CEMAC, real interest rates are much more volatile and low than those in developed countries (France, Germany, United Kingdom), as their evolution shows (Annex 6).
The evolution of real interest rates generally reflects a downward trend between 1980 and 2018 and their values fluctuate sharply between positive and negative values, whereas in developed countries, their evolution is constant between 1980 and 2018 and their values are always positive. Monetary substitution thus expresses the preference of economic agents for stable real interest rates in the main developed countries.
As for the other motives for currency substitution, they are mainly apprehended by the proximity of foreign markets. Indeed, the borders with neighboring non-CEMAC countries are long (Annex 7). As a result, people in border areas are often forced to conduct their transactions outside the country, where access is easier. In such cases, the substitution of currencies of economic agents reflects the demand for foreign exchange to carry out transactions in foreign markets. This is the case for the inhabitants of the border areas of four of the six CEMAC countries (Chad; Congo; Central African Republic and Cameroon).

2.2- For a better effectiveness of monetary policy

Analysis of the basis for currency substitution provides a better basis for considering how to improve the effectiveness of monetary policy. In this perspective, the central bank should promote:
1°) the effective liberalization of the financial system;
2°) better management of the heterogeneity of money demand behaviour under uncertainty.
First of all, with regard to the effective liberalization of the financial system in CEMAC, the tendency of banks to take excessive risk generally translates into a monetary transmission dynamic that is at the root of financial and economic instability.
However, in an environment characterized by currency substitution, such as the CEMAC zone, the proximity of foreign markets forces some economic agents, as noted above, to carry out most of their transactions abroad,

hence their propensity to hold foreign currency. The increase in the national money supply in circulation would therefore have no significant effect on the demand for money in such an environment.
In such an environment, monetary policy is likely to influence the dynamics of speculation and capital flight. An expansive (restrictive, respectively) monetary policy that is characterized by a fall (increase, respectively) in interest rates and an increase (decrease, respectively) in investment could lead to an acceleration (deceleration, respectively) of speculative behavior on the part of economic agents and capital flight. The decrease in interest rates then encourages speculators to seek more profitable investments for their capital, which amplifies currency substitution.
A money demand function augmented by an indicator of currency substitution then reveals to the central bank the importance of the degree of currency substitution in an environment of uncertainty, which would allow monetary policy to act on financing constraints, due to the consolidation of financial intermediation activity.
As regards the management of the heterogeneity of money demand behaviour, it reflects the need for the central bank, in an environment dominated by indirect finance, to have a macroprudential policy. The implications for the monetary policy strategy are therefore based on two types of regimes that are consistent with the Basel III Agreements, namely:
1°) the regime that considers the debt ratio as fixed;
2°) the regime that favors counter-cyclical and pro-cyclical ratios that amplify or moderate bank credit cycles.
Consequently, monetary policy necessarily influences the size of intermediaries' balance sheets and thus financial stability, since short-term interest rates are determinants of the cost of financial leverage. Similarly, the action of macroprudential policy on credit and asset price growth improves the efficiency of the transmission of monetary impulses to the real economy.

III. Conclusion

The present study, based on a money demand function plus a currency substitution indicator, has attempted to show that currency substitution exists in different forms and for different reasons in the CEMAC zone.
With respect to the different forms of currency substitution, the empirical results obtained effectively reveal the existence of the phenomenon of currency substitution only in the long term, with a heterogeneity of situations, in particular :
1°) a member country with no currency substitution (the Central African Republic);
2°) member countries with a high degree of currency substitution (Congo and Chad);
3°) member countries with an average degree of currency substitution (Cameroon and Gabon).
As for the different reasons, two categories of justifications can be evoked:
1°) that which considers financial reasons as the main explanation for currency substitution, notably the absence of a financial market and low real interest rates within the zone ;
2°) that which is interested in non-financial reasons, precisely the proximity of foreign markets on the one hand, and the misappropriation of public funds on the other.
Overall, then, it appears that the use of a money demand function plus a currency substitution indicator makes it possible to significantly improve the effectiveness of monetary policy in the CEMAC zone.

Appendices:

Appendix 1: Summary of unit root test results in the CEMAC zone

	Variable expliquée : Demande d'encaisses réelles (m_t^d)										
	m^d	tcera	inf la	y	g	gouv	cor	bc	sdext	ckn	dep
Cam	I(1)	I(1)	I(1)		I(1)					I(1)	
RCA	I(1)	I(1)	I(1)	I(1)					I(1)		I(1)
Cgo	I(1)		I(1)				I(1)				
Gab	I(1)	I(1)	I(1)		I(1)	I(1)	I(1)				

Tch	I(1)	I(1)	I(1)					I(1)		I(1)	

Appendix 2: Cointegration Test Results

a- Gabon

Date: 12/27/18 Time: 17:35					
Sample: 2008Q1 2018Q4					
Included observations: 42					
Series: M TCERA GOUV INFLA G					
Lags interval: 1 to 1					
Selected (0.05 level*) Number of Cointegrating Relations by Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	1	1	1	2
Max-Eig	0	0	0	1	1

b- Cameroun

Date: 12/27/18 Time: 18:08					
Sample: 2008Q1 2018Q4					
Included observations: 42					
Series: M TCERA INFLA CKN DP					
Lags interval: 1 to 1					
Selected (0.05 level*) Number of Cointegrating Relations by Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	1	1	2	2
Max-Eig	1	1	1	2	2

c- Congo

Date: 12/27/18 Time: 18:45					
Sample: 2008Q1 2018Q4					
Included observations: 42					
Series: M TCERA CKN INFLA COR					
Lags interval: 1 to 1					
Selected (0.05 level*) Number of Cointegrating Relations by Model					

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	1	1	2	2
Max-Eig	1	1	1	2	2

d- Centrafrique

Date: 12/27/18 Time: 20:08					
Sample: 2008Q1 2018Q4					
Included observations: 42					
Series: M TCERA INFLA Y DEP COR SDEXT					
Lags interval: 1 to 1					
Selected (0.05 level*) Number of Cointegrating Relations by Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	2	1	2	3	3
Max-Eig	1	1	1	2	2

e- Tchad

Date: 12/27/18 Time: 21:06					
Sample: 2008Q1 2018Q4					
Included observations: 42					
Series: M TCERA INFLA SDEXT BC					
Lags interval: 1 to 1					
Selected (0.05 level*) Number of Cointegrating Relations by Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	1	1	1	2
Max-Eig	1	1	1	2	2

Appendix 3: Error Correction Template

a-Gabon

Vector Error Correction Estimates					
Date: 12/27/18 Time: 17:34					
Sample (adjusted): 2008Q3 2018Q4					
Included observations: 42 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
Cointegrating Eq:	CointEq1				

M(-1)	1.000000				
TCERA(-1)	-9.976840				
	(2.61402)				
	[-3.81666]				
GOUV(-1)	-525.1312				
	(231.119)				
	[-2.27213]				
INFLA(-1)	83.59360				
	(59.0968)				
	[1.41452]				
G(-1)	5.131314				
	(1.05325)				
	[4.87190]				
C	-60.79779				
Error Correction:	D(M)	D(TCERA)	D(GOUV)	D(INFLA)	D(G)
CointEq1	-0.015563	-0.096982	0.000979	-0.002228	-0.256026
	(0.00525)	(0.02812)	(0.00030)	(0.00052)	(0.05287)
	[-2.96720]	[-3.44912]	[3.26752]	[-4.24791]	[-4.84237]
D(M(-1))	-0.603996	-2.630118	0.024614	-0.031265	-5.577003
	(0.67689)	(3.62866)	(0.03868)	(0.06768)	(6.82324)
	[-0.89231]	[-0.72482]	[0.63636]	[-0.46194]	[-0.81735]
D(TCERA(-1))	-0.073150	-0.429135	0.002695	-0.016290	-0.684473
	(0.16140)	(0.86524)	(0.00922)	(0.01614)	(1.62697)
	[-0.45322]	[-0.49597]	[0.29221]	[-1.00938]	[-0.42070]
D(GOUV(-1))	-6.054280	-43.56824	0.122460	-1.189804	-133.1832
	(9.63703)	(51.6620)	(0.55070)	(0.96361)	(97.1439)
	[-0.62823]	[-0.84333]	[0.22237]	[-1.23474]	[-1.37099]
D(INFLA(-1))	1.563769	3.562575	-0.073479	0.240557	17.16779
	(2.70916)	(14.5232)	(0.15481)	(0.27089)	(27.3090)
	[0.57722]	[0.24530]	[-0.47463]	[0.88803]	[0.62865]
D(G(-1))	0.034296	0.150072	-0.001771	0.003073	0.048754
	(0.05455)	(0.29245)	(0.00312)	(0.00545)	(0.54991)
	[0.62868]	[0.51316]	[-0.56810]	[0.56337]	[0.08866]
C	-0.047788	-0.480027	0.004206	-0.005556	-1.251884
	(0.27840)	(1.49242)	(0.01591)	(0.02784)	(2.80630)
	[-0.17165]	[-0.32164]	[0.26441]	[-0.19959]	[-0.44610]
R-squared	0.369875	0.389124	0.385374	0.438051	0.487008
Adj. R-squared	0.261853	0.284402	0.280009	0.341717	0.399066
Sum sq. resids	112.1886	3224.069	0.366346	1.121664	11399.70
S.E. equation	1.790360	9.597722	0.102309	0.179018	18.04732
F-statistic	3.424082	3.715793	3.657531	4.547212	5.537861
Log likelihood	-80.22816	-150.7507	39.98334	16.48457	-177.2725

Akaike AIC	4.153722	7.511940	-1.570635	-0.451646	8.774883
Schwarz SC	4.443334	7.801552	-1.281023	-0.162035	9.064495
Mean dependent	-0.072857	-0.613095	0.005238	-0.008976	-1.606667
S.D. dependent	2.083862	11.34576	0.120573	0.220643	23.28088
Determinant resid covariance (dof adj.)		0.019783			
Determinant resid covariance		0.007951			
Log likelihood		-196.4523			
Akaike information criterion		11.25963			
Schwarz criterion		12.91455			

b- Cameroun

Vector Error Correction Estimates					
Date: 12/27/18 Time: 18:06					
Sample (adjusted): 2008Q3 2018Q4					
Included observations: 42 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
Cointegrating Eq:	CointEq1				
M(-1)	1.000000				
TCERA(-1)	-0.518935				
	(0.23344)				
	[-2.22296]				
INFLA(-1)	-5.144088				
	(4.76450)				
	[-1.07967]				
CKN(-1)	-1360.226				
	(243.991)				
	[-5.57490]				
DP(-1)	0.933788				
	(0.09834)				
	[9.49506]				
C	-0.982542				
Error Correction:	D(M)	D(TCERA)	D(INFLA)	D(CKN)	D(DP)
CointEq1	-0.191736	-0.884108	-0.019005	-0.001295	-3.713032
	(0.07087)	(0.24330)	(0.00660)	(0.00030)	(0.61402)
	[-2.70555]	[-3.63380]	[-2.88015]	[-4.31735]	[-6.04711]
D(M(-1))	-0.477661	-1.678379	-0.027910	0.000134	-2.184256
	(0.60832)	(2.08845)	(0.05664)	(0.00257)	(5.27061)
	[-0.78522]	[-0.80365]	[-0.49275]	[0.05202]	[-0.41442]
D(TCERA(-1))	-0.278934	-0.901441	-0.026682	-0.001799	-2.792867
	(0.23930)	(0.82155)	(0.02228)	(0.00101)	(2.07335)
	[-1.16563]	[-1.09724]	[-1.19749]	[-1.77688]	[-1.34703]

D(INFLA(-1))	5.112065	19.45542	0.512411	0.029278	72.88285
	(5.27776)	(18.1194)	(0.49142)	(0.02233)	(45.7279)
	[0.96861]	[1.07373]	[1.04272]	[1.31095]	[1.59384]
D(CKN(-1))	71.81455	203.9325	4.246186	-0.122613	-239.0658
	(133.308)	(457.669)	(12.4125)	(0.56411)	(1155.02)
	[0.53871]	[0.44559]	[0.34209]	[-0.21736]	[-0.20698]
D(DP(-1))	0.041518	0.136795	0.003690	0.000305	0.537846
	(0.05842)	(0.20056)	(0.00544)	(0.00025)	(0.50616)
	[0.71068]	[0.68205]	[0.67841]	[1.23535]	[1.06259]
C	-0.167810	-0.728743	-0.010633	-0.001178	-2.599756
	(0.41348)	(1.41954)	(0.03850)	(0.00175)	(3.58249)
	[-0.40585]	[-0.51337]	[-0.27619]	[-0.67321]	[-0.72568]
R-squared	0.383703	0.456944	0.361396	0.515316	0.616963
Adj. R-squared	0.278052	0.363849	0.251921	0.432228	0.551300
Sum sq. resids	248.4721	2928.654	2.154174	0.004449	18652.69
S.E. equation	2.664433	9.147450	0.248088	0.011275	23.08536
F-statistic	3.631796	4.908354	3.301180	6.202007	9.395847
Log likelihood	-96.92630	-148.7326	2.780086	132.6106	-187.6130
Akaike AIC	4.948871	7.415839	0.200948	-5.981458	9.267286
Schwarz SC	5.238483	7.705451	0.490560	-5.691847	9.556898
Mean dependent	-0.136190	-0.613333	-0.007143	-0.000929	-2.226429
S.D. dependent	3.135824	11.46885	0.286835	0.014963	34.46344
Determinant resid covariance (dof adj.)		0.000211			
Determinant resid covariance		8.48E-05			
Log likelihood		-101.0911			
Akaike information criterion		6.718625			
Schwarz criterion		8.373549			

c- Congo

Vector Error Correction Estimates					
Date: 12/27/18 Time: 18:45					
Sample (adjusted): 2008Q3 2018Q4					
Included observations: 42 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
Cointegrating Eq:	CointEq1				
M(-1)	1.000000				
TCERA(-1)	-49.63027				
	(11.3258)				
	[-4.38205]				
CKN(-1)	6376.602				
	(822.819)				
	[7.74971]				

INFLA(-1)	-42.34851				
	(11.2653)				
	[-3.75920]				
COR(-1)	194.6816				
	(38.0694)				
	[5.11386]				
C	-45.70440				
Error Correction:	D(M)	D(TCERA)	D(CKN)	D(INFLA)	D(COR)
CointEq1	-0.012895	-0.004679	-0.000212	-0.004213	-0.002710
	(0.00344)	(0.00347)	(2.8E-05)	(0.00139)	(0.00045)
	[-3.75097]	[-1.34731]	[-7.49859]	[-3.02471]	[-6.03031]
D(M(-1))	-0.471134	0.076669	0.001552	-0.063113	-0.009749
	(0.16873)	(0.17046)	(0.00139)	(0.06836)	(0.02206)
	[-2.79229]	[0.44977]	[1.12071]	[-0.92326]	[-0.44198]
D(TCERA(-1))	0.020848	-0.810903	-0.004123	0.240139	0.110011
	(0.24643)	(0.24897)	(0.00202)	(0.09984)	(0.03222)
	[0.08460]	[-3.25704]	[-2.03797]	[2.40521]	[3.41476]
D(CKN(-1))	32.60977	30.22172	0.138446	13.93059	5.000798
	(22.2144)	(22.4430)	(0.18238)	(9.00005)	(2.90410)
	[1.46796]	[1.34660]	[0.75909]	[1.54783]	[1.72198]
D(INFLA(-1))	-0.159949	-0.034983	-0.005065	-0.101369	-0.056561
	(0.48154)	(0.48649)	(0.00395)	(0.19509)	(0.06295)
	[-0.33216]	[-0.07191]	[-1.28118]	[-0.51960]	[-0.89848]
D(COR(-1))	1.255985	-1.971009	0.013325	0.103161	0.106923
	(1.25083)	(1.26370)	(0.01027)	(0.50677)	(0.16352)
	[1.00412]	[-1.55971]	[1.29757]	[0.20357]	[0.65388]
C	-0.023542	-0.077153	-0.000145	-0.020978	-0.008721
	(0.11292)	(0.11408)	(0.00093)	(0.04575)	(0.01476)
	[-0.20848]	[-0.67629]	[-0.15678]	[-0.45855]	[-0.59076]
R-squared	0.693848	0.367161	0.837711	0.786862	0.918044
Adj. R-squared	0.641365	0.258674	0.809890	0.750324	0.903995
Sum sq. resids	17.81615	18.18470	0.001201	2.924380	0.304486
S.E. equation	0.713465	0.720807	0.005858	0.289057	0.093272
F-statistic	13.22040	3.384385	30.11084	21.53542	65.34329
Log likelihood	-41.58657	-42.01655	160.1134	-3.639085	43.86738
Akaike AIC	2.313646	2.334121	-7.291113	0.506623	-1.755590
Schwarz SC	2.603258	2.623733	-7.001501	0.796235	-1.465978
Mean dependent	-0.028095	0.007857	0.000000	-0.032381	-0.015238
S.D. dependent	1.191370	0.837172	0.013435	0.578488	0.301025
Determinant resid covariance (dof adj.)		1.71E-09			
Determinant resid covariance		6.86E-10			
Log likelihood		145.1332			
Akaike information criterion		-5.006341			
Schwarz criterion		-3.351417			

d-Centrafrique

Vector Error Correction Estimates							
Date: 12/27/18 Time: 20:07							
Sample (adjusted): 2008Q3 2018Q4							
Included observations: 42 after adjustments							
Standard errors in ( ) & t-statistics in [ ]							
Cointegrating Eq:	CointEq1						
M(-1)	1.000000						
TCERA(-1)	0.849614						
	(0.06731)						
	[12.6216]						
INFLA(-1)	0.487997						
	(0.07548)						
	[6.46516]						
Y(-1)	-8.785659						
	(0.70263)						
	[-12.5039]						
DEP(-1)	0.728428						
	(0.33393)						
	[2.18135]						
COR(-1)	-0.619904						
	(0.30851)						
	[-2.00932]						
SDEXT(-1)	-23.17895						
	(8.80683)						
	[-2.63193]						
C	0.095490						
Error Correction:	D(M)	D(TCERA)	D(INFLA)	D(Y)	D(DEP)	D(COR)	D(SDEXT)
CointEq1	-0.254612	-18.59454	-0.640723	-1.674773	-0.645929	-0.406354	-0.005722
	(0.10538)	(5.38500)	(0.22448)	(0.54155)	(0.18207)	(0.14936)	(0.00124)
	[-2.41620]	[-3.45302]	[-2.85430]	[-3.09254]	[-3.54772]	[-2.72063]	[-4.62372]
D(M(-1))	-17.81372	-778.7927	-26.88884	-78.17362	-30.54929	-26.16545	-0.121430
	(5.25550)	(268.568)	(11.1954)	(27.0090)	(9.08039)	(7.44910)	(0.06172)
	[-3.38954]	[-2.89979]	[-2.40177]	[-2.89435]	[-3.36432]	[-3.51257]	[-1.96746]
D(TCERA(-1))	-0.936491	-38.98675	-1.394433	-3.942611	-1.568255	-1.368480	-0.006250
	(0.31752)	(16.2258)	(0.67638)	(1.63178)	(0.54860)	(0.45004)	(0.00373)
	[-2.94943]	[-2.40276]	[-2.06161]	[-2.41615]	[-2.85865]	[-3.04077]	[-1.67625]
D(INFLA(-1))	-0.069702	-4.215682	0.007243	-0.418705	-0.124381	-0.111183	-0.000785
	(0.11627)	(5.94177)	(0.24769)	(0.59754)	(0.20089)	(0.16480)	(0.00137)

	[-0.59947]	[-0.70950]	[0.02924]	[-0.70071]	[-0.61914]	[-0.67465]	[-0.57512]
D(Y(-1))	9.157334	380.0868	13.46211	38.43207	15.32437	13.46735	0.061136
	(3.13395)	(160.152)	(6.67604)	(16.1060)	(5.41480)	(4.44204)	(0.03680)
	[2.92198]	[2.37328]	[2.01648]	[2.38620]	[2.83009]	[3.03180]	[1.66112]
D(DEP(-1))	10.59959	462.9270	16.22158	46.45782	18.24024	15.41250	0.073445
	(3.14059)	(160.492)	(6.69018)	(16.1401)	(5.42627)	(4.45144)	(0.03688)
	[3.37503]	[2.88443]	[2.42469]	[2.87841]	[3.36147]	[3.46236]	[1.99134]
D(COR(-1))	-0.180422	-3.571504	-0.036808	-0.359024	-0.336696	-0.327837	-0.000340
	(0.42813)	(21.8787)	(0.91202)	(2.20026)	(0.73972)	(0.60683)	(0.00503)
	[-0.42141]	[-0.16324]	[-0.04036]	[-0.16317]	[-0.45516]	[-0.54024]	[-0.06758]
D(SDEXT(-1))	3.021695	34.61062	3.476949	7.003861	0.956603	-1.091662	-0.010656
	(15.1075)	(772.027)	(32.1824)	(77.6402)	(26.1025)	(21.4132)	(0.17742)
	[0.20001]	[0.04483]	[0.10804]	[0.09021]	[0.03665]	[-0.05098]	[-0.06006]
C	-0.006871	-0.415123	-0.004859	-0.040172	-0.013934	-0.011218	0.000100
	(0.02789)	(1.42544)	(0.05942)	(0.14335)	(0.04819)	(0.03954)	(0.00033)
	[-0.24632]	[-0.29123]	[-0.08177]	[-0.28024]	[-0.28912]	[-0.28373]	[0.30621]
R-squared	0.479608	0.499926	0.403283	0.479308	0.535333	0.499425	0.484182
Adj. R-squared	0.353452	0.378696	0.258624	0.353080	0.422686	0.378074	0.359135
Sum sq. resids	1.054035	2752.561	4.783078	27.83843	3.146557	2.117552	0.000145
S.E. equation	0.178719	9.132960	0.380712	0.918471	0.308788	0.253315	0.002099
F-statistic	3.801716	4.123776	2.787822	3.797151	4.752324	4.115524	3.872002
Log likelihood	17.79051	-147.4304	-13.97113	-50.95912	-5.176843	3.140165	204.4568
Akaike AIC	-0.418596	7.449066	1.093863	2.855196	0.675088	0.279040	-9.307469
Schwarz SC	-0.046238	7.821424	1.466221	3.227554	1.047446	0.651398	-8.935111
Mean dependent	-0.009048	-0.613571	-0.009524	-0.057857	-0.020000	-0.015476	3.81E-05
S.D. dependent	0.222265	11.58669	0.442158	1.141931	0.406401	0.321211	0.002622
Determinant resid covariance (dof adj.)		1.22E-17					
Determinant resid covariance		2.25E-18					
Log likelihood		436.2151					
Akaike information criterion		-17.43881					
Schwarz criterion		-14.54270					

e-Tchad

Vector Error Correction Estimates					
Date: 12/27/18 Time: 21:06					
Sample (adjusted): 2008Q3 2018Q4					
Included observations: 42 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
Cointegrating Eq:	CointEq1				
M(-1)	1.000000				
TCERA(-1)	-10.37595				
	(1.23505)				
	[-8.40127]				

INFLA(-1)	3.917089				
	(0.48625)				
	[8.05579]				
SDEXT(-1)	-912.6748				
	(117.222)				
	[-7.78587]				
BC(-1)	-0.282386				
	(0.02749)				
	[-10.2706]				
C	-0.031874				
Error Correction:	D(M)	D(TCERA)	D(INFLA)	D(SDEXT)	D(BC)
CointEq1	-0.088764	0.050675	-0.029661	-0.000556	5.938136
	(0.02628)	(0.02246)	(0.04586)	(0.00019)	(0.97451)
	[-3.37820]	[2.25608]	[-0.64683]	[-2.92546]	[6.09345]
D(M(-1))	-0.304309	0.083754	-0.038459	-0.001209	2.313992
	(0.21593)	(0.18458)	(0.37684)	(0.00156)	(8.00833)
	[-1.40931]	[0.45375]	[-0.10206]	[-0.77403]	[0.28895]
D(TCERA(-1))	0.575035	-0.317000	0.664011	0.011377	6.960612
	(0.17617)	(0.15060)	(0.30745)	(0.00127)	(6.53377)
	[3.26410]	[-2.10497]	[2.15974]	[8.93079]	[1.06533]
D(INFLA(-1))	0.221664	-0.030210	0.261682	0.001993	-14.01373
	(0.13541)	(0.11575)	(0.23632)	(0.00098)	(5.02208)
	[1.63698]	[-0.26099]	[1.10734]	[2.03580]	[-2.79042]
D(SDEXT(-1))	-32.05003	-10.20875	-33.88068	-0.279892	2914.907
	(26.0374)	(22.2577)	(45.4402)	(0.18828)	(965.675)
	[-1.23092]	[-0.45866]	[-0.74561]	[-1.48654]	[3.01852]
D(BC(-1))	-0.008467	0.005190	-0.006406	-5.76E-05	0.508370
	(0.00548)	(0.00468)	(0.00956)	(4.0E-05)	(0.20314)
	[-1.54577]	[1.10848]	[-0.67019]	[-1.45369]	[2.50257]
C	-0.021532	-0.017360	0.030611	1.50E-05	2.897614
	(0.09693)	(0.08286)	(0.16915)	(0.00070)	(3.59477)
	[-0.22215]	[-0.20952]	[0.18097]	[0.02147]	[0.80606]
R-squared	0.694061	0.439348	0.291366	0.869339	0.636646
Adj. R-squared	0.641614	0.343236	0.169885	0.846940	0.574356
Sum sq. resids	13.53742	9.892372	41.23074	0.000708	18620.96
S.E. equation	0.621919	0.531638	1.085367	0.004497	23.06572
F-statistic	13.23366	4.571211	2.398461	38.81135	10.22079
Log likelihood	-35.81898	-29.23140	-59.20722	171.2133	-187.5773
Akaike AIC	2.038999	1.725305	3.152725	-7.819680	9.265584
Schwarz SC	2.328610	2.014916	3.442337	-7.530069	9.555195
Mean dependent	-0.032619	0.005690	0.008333	-0.000433	1.576429
S.D. dependent	1.038864	0.656011	1.191263	0.011495	35.35444

Determinant resid covariance (dof adj.)	0.000221				
Determinant resid covariance	8.88E-05				
Log likelihood	-102.0554				
Akaike information criterion	6.764542				
Schwarz criterion	8.419465				

Appendix 3: Short- and long-term coefficients

a) Short-term coefficients

	Variable expliquée : Demande d'encaisses réelles (m_t^d)										FR
	tcera	inf *la*	*y*	*g*	*gouv*	*cor*	*bc*	*sdext*	*ckn*	*dep*	
Cam	– 0,27 (–1,16)	5,11 (0,96)		0,41 (0,71)					71,81 (0,53)		– 0,19 (–2,70)
RCA	– 0,93 (–2,94)	– 0,069 (–0,59)	9,15 (2,37)					3,02 (0,20)		10,59 (3,37)	– 0,25 (–2,41)
Cg	0,02 (0,084)	– 0,15 (1,46)				1,25 (1,005)					– 0,012 (–3,75)
Gab	– 0,073 (–0,45)	1,56 (0,57)		0,03 (062)	– 6,05 (–0,62)	– 0,18 (–0,42)					– 0,015 (–2,96)
Tch	0,57 (3,26)	0,22 (1,63)					– 0,008 (–1,54)		– 32,05 (–1,23)		– 0,088 (–3,37)

b) Long-term coefficients

	Variable expliquée : Demande d'encaisses réelles (m_t^d)									
	tcera	inf *la*	*y*	*g*	*gouv*	*cor*	*bc*	*sdext*	*ckn*	*dep*
Cam	– 0,51 (–2,22)	– 5,14 (–1,07)		0,93 (9,49)					– 1360,22 (–5,57)	
RCA	0,84 (12,62)	0,48 (6,46)	– 8,78 (–12,5)			– 0,61 (–2,009)		– 23,17 (–2,63)		0,72 (2,18)
Cg	– 49,63 (–4,38)	– 42,34 (–3,75)				194,68 (5,11)				
Gab	– 2,27 (–9,97)	83,59 (1,41)		5,13 (4,87)	– 525,13 (–2,27)					
Tch	– 10,37 (–8,40)	3,91 (8,05)					– 0,28 (–10,27)	– 912,67 (–7,78)		

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