Factors explaining the real effective exchange rate in franc zone: a new view

Abstract:

Although there is an abundant literature on the determinants of the real effective exchange rate, no study has focused specifically on all the African countries in the Franc zone, whose currencies are still pegged to the euro by a fixed parity, despite the end of the gold standard in 1971. The main objective of this article is to identify the main factors explaining the real effective exchange rate in the franc zone. The data used in this work cover 15 countries that use the CFA franc over the period 1990-2019. To achieve our objective, we mobilized several estimation methods such as the Driscoll and Kraay method, the Panel Corrected Standard Error (PCSE) and the Feasible Generalized Least Squares (FGLS) method. The results of this study reveal that inflation, money supply, the interest rate, gross domestic product per capita, imports and direct investment are the main determinants of the real effective exchange rate in the franc zone.

Keywords: Driscoll and Kraay, Exchange rate, FGLS, Franc zone, PCSE

1. Introduction

The pace of a country's economic growth has a greater or lesser influence on the demand for its currency. For example, a country experiencing sustained economic growth is more likely to attract international investors, which fuels the conversion of foreign currency into domestic currency, causing the latter to appreciate on the foreign exchange market. The current account balance also has the same effect: an external deficit increases demand for foreign currency, leading to a fall in the exchange rate, while a surplus has the opposite effect. Finally, performance in the fight against inflation also plays a role. According to the theory of purchasing power parities, a country with a higher inflation rate than its trading partner should see its exchange rate weaken.

A growing financial sector, on the other hand, allows for rapid adjustment of relative prices, providing flexibility in the foreign exchange markets to cushion macroeconomic shocks. The fixed exchange rate system also encourages production growth and economic integration. In other words, companies that know the exchange rate between two currencies in advance can better manage their risks and investments. Nevertheless, the fixed exchange rate slows down external adjustment, limits the use of macroeconomic policies and increases vulnerability to crises.

Choosing an exchange rate regime for a developing country is always a difficult decision. The real exchange rate, which expresses the relative price of local goods compared with the price of foreign goods, and more generally the price of internationally traded goods compared with non-traded or domestic goods, influences the entire price structure and thus has multiple financial, economic and social impacts Jeanneney (2019).

Originally conceived as a theory of exchange rate determination, Purchasing Power Parity is mainly used today to compare living standards between countries. It was first used as a theory of exchange rate determination in the work of Gustav Cassel (1916), who proposed

using PPP to establish what adjustment should be made to exchange rates or parities prior to the First World War, in the case of countries wishing to return to the gold standard at the end of hostilities. As a theory of exchange rate determination, PPP in its simplest and most rigorous form (absolute PPP) is based on a version of the law of one price applied to an international basket of goods. The theory of PPP has been the subject of much controversy, mainly because of its logical and simple nature. Barriers to international trade can asymmetrically influence relative prices by disrupting special arbitrage. If a country's imports are relatively more restricted than its exports, its exchange rate will be higher than its purchasing power parity level.

However, we should also note that Purchasing Power Parity (PPP) is the oldest theory for determining interest rates and exchange rates. It establishes a link between exchange rate movements between two currencies and the change in the general price level of goods and services observed in the areas concerned. PPP is based on the law of one price. "This law states that in competitive markets, with no transport costs and no official barriers to trade (such as customs duties), identical goods marketed in different countries should be sold at the same price when expressed in the same currency" (Krugman, 2015).

According to the monetary approach, an increase in a country's money supply causes its currency to depreciate on the exchange market, while a reduction in the money supply creates an appreciation of its currency. The monetarist approach differs greatly from "real" exchange rate analyses: according to this approach, the determination of the exchange rate primarily reflects the equilibrium of the money market. Exchange rate movements are linked to the balance of official settlements and not to current transactions. Furthermore, developed in the 1970s, notably by Frenkel (1976), the monetarist theory of the exchange rate is situated within the framework of the flexible exchange rate regime, the superiority of which it seeks to demonstrate over the fixed exchange rate regime that has just been abandoned.

Empirically, several authors have found a positive relationship on the factors that determine the exchange rate, Khin et *al*, (2017), examined the determinants of the exchange rate for the Malaysian economy. The study found that there is a positive and substantial relationship between the exchange rate, inflation rate and the logarithm of the exchange rate. The study also concluded that money supply is negatively and significantly associated with the exchange rate.

Adusei and Gyapong (2017), conducted a study using partial least squares equation model on Ghana's data for the period of 1975-2014. The result of the study revealed that money supply, current account balance, GDP and GDP growth rate are key forecasters of the exchange rate. In similar studies, Hassan et *al*, (2017), also explored the different factors contributing to the exchange rate. The study was based on data from Nigeria, for the period 1989 to 2015. The analysis concluded that fiscal balance, trade openness and oil prices have a positive relationship with the country's exchange rate. More, Alagided and Ibrahim (2017), used data from Ghana for the period 1980 to 2013 and concluded that government expenditure, money supply and foreign direct investment inflows affect the exchange rate in the long run. However, Cevik et *al*, (2016), used the GMM model which included data from 115 countries for the period 1996 to 2011. Insah and chairak (2013), applied ARDL for Ghana using data for the period 1980 to 2012 and their result also revealed the positive impact of government spending on the exchange rate. They also reported a positive association for money supply, domestic shocks and external shocks, which negatively affect the exchange rate.

Furthermore, Oswald (2020), attempts to explain the movements of Zambia's real effective exchange rate using a vector error correction model and quarterly time series data between 1973 and 1997. The study results are similar to most studies about the nature of the determinants of the real exchange rate. Through the use of purchasing power parity tests, impulse response and variance decomposition functions, the study indicates that Zambia's real effective exchange rate depends significantly on the prevailing real fundamentals, price differentials and real shocks

The study conducted by Morales-Zumaquero and Sosvilla-Rivero (2016), argued that a country's exchange rate is influenced by a specific country's regime. The study found that the mindset of a regime is vital in stabilizing the exchange rate. The study also found that commodity prices in different regimes significantly describe the volatility of a country's exchange rate. However, in a similar study conducted by Parker and Wong (2014), shows that a country's exchange rate is mainly affected by the country's export and other factors. Ajao (2015), argued that price stability, investment and economic stability can be essential to explain the volatility of exchange rate in a country.

Wonyra (2018), shows how Rondet, Saxegard and Tsangarides (2007) tried to determine the ERER of the CFA franc in the WAEMU and quantify its impact on competitiveness. To do this, they used the approach of Edwards (1989) and modelling on a country-by-country basis and then on a panel basis. They conclude that in many cases, the behavior of the REER in the WAEMU is explained by fluctuations in fundamentals such as the terms of trade, government spending, investment and productivity. Moreover, estimation using the single-equation model gives different results for different WAEMU countries.

According to Ozekhome (2021), an unsupported government leads to an overvaluation of the exchange rate. The results further show that nominal devaluation has a significant negative effect on the real exchange rate, while delayed nominal devaluation has a significant positive effect on the real exchange rate. He also notes that excess domestic credit supply also has a significant positive influence on the real exchange rate, implying that an increase in domestic credit supply leads to an appreciation of the exchange rate. Finally, lagged growth differentials have a positive and significant influence on the real exchange rate. Waheed, (2016, p. 62), examines the determinants of the real effective exchange rate in Nigeria for the period 1960 to 2015 using the vector error correction mechanism to separate long-run fundamentals from short-run fundamentals. The findings of the regression estimates revealed that the terms of trade, openness of the economy, net capital inflows and total government expenditure were the main long-run determinants of the country's real effective exchange rate. While variables such as money supply (M2), nominal effective exchange rate, June 12 crisis and civil regime change were revealed as the main determinants of the exchange rate in Nigeria between 1960 and 2015. The study recommends that when the main terms of trade variable (crude oil price) is beyond the control of governments, the effect of shocks due to crude oil price fluctuations can be minimized by shifting the economy from a single product country and diversifying the economy to increase production capacity.

More, Jongbo, (2022), indicated that there is no significant relationship between real terms of trade and real exchange rate in Nigeria; there is no significant relationship between real trade restrictions and real exchange rate in Nigeria; there is no significant relationship between technological progress and real exchange rate in Nigeria. However, it is demonstrated that there is a significant relationship between real government expenditure and real exchange rate in Nigeria and there is a significant relationship between nominal exchange

rate and real exchange rate in Nigeria. Therefore, the study concluded that, at the long run level, the real variables alone that influences real exchange rate in Nigeria were insignificant. However, real exchange rate in Nigeria was determined by both real and nominal variables are the core fundamentals that determined real exchange rate in Nigeria mostly in the short run. It is therefore recommended that there is need for the monetary authority in Nigeria to create enabling environment that will encourage and attract international trade activities by investing in the infrastructure of the nation.

The work of Baharumshah et *al*, (2017) stated that inflation has a profound impact on exchange rate. In the similar studies, Ghosh (2013) stated the importance of trade openness and inflation rate in affecting the exchange rate. Ozkan and Erden (2015), analyzed data from 88 countries and found that output gap, inflation rate and trade openness do affect the exchange rate.

However, the work of Rashid and Basit (2021), reveal for its part that the current period volatility of exchange rates is significantly affected by ERV in the previous period in all selected countries. The results also indicate that the volatilities of the underlying macroeconomic variables are quite differently related to ERV in examined Asian countries. Foreign-reserve volatility (VFXRES) has negative and significant impacts on ERV in Bangladesh, China and Malaysia. Government-spending volatility is negatively related to ERV in India, whereas it is positively related to ERV in all other examined countries. The results also suggest that although terms-of-trade volatility reduces ERV in both Bangladesh and Pakistan, it amplifies ERV in the remaining examined countries. However, gold-price volatility (VGOLDP) significantly, positively contributes to ERV in Bangladesh, Indonesia and Malaysia. On the contrary, the higher volatility in industrial production (VIPI) results in lower ERV in Indonesia and Pakistan, whereas it increases ERV in China, India and Malaysia.

Our study differs from that of others in that the world has always operated on the gold standard until 1971, after which all countries migrated to a flexible exchange rate system, with the exception of the franc zone countries, which have remained pegged to the euro via a fixed exchange rate system until the present day. Thus, these countries with a flexible exchange rate system will see their monetary policies independent and effective. Furthermore, we are going to carry out an analysis of heterogeneity, i.e. to understand the determinants of the real exchange rate in the franc zone while making an overall analysis (franc zone) on the one hand and an analysis by sub-region (WAEMU, CAEMC and COMORES) on the other hand. However, it should be remembered that some studies were carried out well before ours, but none of them took a particular interest in the African countries of the franc zone (ACFZ), even though it is the only zone in the world that has remained within the fixed exchange rate system.

Despite the abundant literature on the determinants of the REER, the specificity of franc zone countries has not yet been highlighted in this literature. It is for this reason that this article aims to fill the gap in the literature by analyzing the determinants of the real effective exchange rate not only in the ACFZ as a whole, but also in the groups of countries that make up the zone. Moreover, only economic factors are taken into account in this work. In the light of the previous literature, we conclude that economic factors contribute significantly to explaining the REER.

The rest of the study is organized as follows. Section 2 describes the data sources used to investigate the main determinants of the real effective exchange rate in the franc zone. Section 3 interprets our empirical results, while Section 4 concludes

2. Data sources and econometric specification

2.1. Data sources

The population of the study consists of the various African countries of the franc zone divided into three sub-regions. The countries of the West African Economic and Monetary Union (WAEMU), the countries of the Central African Economic and Monetary Community (CAEMC) and the Comorian Union. The study covers the period from 1990 to 2019, and the data used in the report come respectively from the World Bank (WDI 2020), the International Monetary Fund (IMF 2020), World Outlook (PM 2020) and the United Nations Conference on Trade and Development (UNCTAD 2020).

The variables in our study are constituted as follows: the dependent variable is the real effective exchange rate (REER), which is a comparative measure of prices between the reference country and foreign countries, expressed in the same currency (Goujon, 2007). As independent variables, we used the interest rate (Ir). The work of Yu-Hsing (2006) and Stancik (2006) has shown that this variable explains the REER negatively and significantly. Studies by Beatrice (2001) have shown that imports (Imp) have a positive and significant influence on the REER. Contrary to Parker and Wong (2014), exports (Exp) explain negatively and significantly the REER. Foreign direct investment (Fdi), positively and significantly explains the REER (Alagided and Ibrahim, 2017). Gross domestic product per capita (Gdppc) positively/negatively and significantly explains the REER (MacDonald and Ricci, 2003); Adusei and Gyapong (2017), Drine and Rault (2003). As for the money supply (m), it can have a positive/negative influence on the REER (Alagided and Ibrahim, 2017; Yu-Hsing, 2006; Stancik, 2006; Khin et *al*, 2017). Finally, inflation (Inf) is positively and significantly correlated with the REER (Ozkan and Erden, 2015; Khin et al, 2017).

2.1.1. Descriptive statistics

Table 1 summarizes the variables in the model using a number of indicators. The table shows that the average exchange rate is 4.31%. The median of this variable is 2.01%, which means that 50% of the countries in the sample have an exchange rate below 2.01%, while the remaining 50% have an exchange rate above 2.01%. The average import rate is 35.45%, while the average export rate is 39.75%.

The correlation matrix is shown in Table 2. Analysis of the correlation coefficients shows that all the explanatory variables are strongly correlated with the real effective exchange rate indicators. Moreover, the correlation coefficient between the explanatory variables of the model is less than 87%, which demonstrates that our model does not suffer from the problem of multicollinearity (according to Thumb's rule).

Table 1: Descriptive statistics

	Reer	Exp	Fdi	Imp	Inf	Gdppc	Ir	m
Mean	4.317388	39.75428	6.847472	35.45775	3.848006	9.690703	3.122667	20,767
Median	2.018640	36.46647	2.250000	32.83870	2.714500	9.822799	3.059000	18,919
Maximum	9.613840	89.22435	161.8240	113.6609	42.44000	10.59115	9.168000	68,869

Minimum	1.756674	9.841650	-8.703000	9.768126	-11.68600	8.003491	-4.191000	5,143
Std. Dev.	3.299926	21.87479	17.02859	14.98153	7.320358	0.566282	2.199868	9,193
Observations	180	180	180	180	180	180	180	180

Sources: Authors using Stata14 software

2.1.2. Simple correlation coefficients for the real effective exchange rate in the franc zone

The analysis of the correlation between the explanatory variables and the real effective exchange rate indicators is presented in the table below:

Table 2: Correlation analysis

Corrélation	Reer	Inf	m	Ir	Gdppc	Imp	Fdi	Exp
Reer	1.0000							
Inf	-0.1177	1.0000						
m	-0.1096	-0.0815	1.0000					
Ir	0.1154	-0.0331	-0.0637	1.0000				
Gdppc	0.0658	-0.3703	0.1910	-0.1308	1.0000			
Imp	0.0684	0.0848	0.1504	-0.0331	0.0332	1.0000		
Fdi	-0.0508	-0.0187	0.1826	0.0012	0.0093	-0.0066	1.0000	
Exp	-0.0493	0.2213	-0.1094	-0.0136	-0.5700	-0.0521	-0.0022	1.0000

Source: Authors based on Stata14 software

2.2. Econometric specification

The objective of this first part is to investigate the main determinants of the exchange rate in the franc zone. According to the recent literature on exchange rate determinants (Owoundi, 2015), we formulate the following model:

$$\mathbf{TCER_{it}} = \begin{Bmatrix} \boldsymbol{\beta_0} + \boldsymbol{\beta_1 Imf_{it}} + \boldsymbol{\beta_2 m_{it}} + \boldsymbol{\beta_3 Ir_{it}} + \boldsymbol{\beta_4 Gdpc_{it}} + \\ \boldsymbol{\beta_5 Imp_{it}} + \boldsymbol{\beta_6 Fdi_{it}} + \boldsymbol{\beta_7 Exp_{it}} + \mathbf{u_i} + \mathbf{v_t} + \boldsymbol{\varepsilon_{it}} \end{Bmatrix} \#(1)$$

Where u_i is the unobserved country-specific effect, v_t is the time-specific effect and ε_{it} is the error term.

This model is obtained using the behavioral equilibrium exchange rate (BEER) introduced by Clark and MacDonald (1998), which is a model used to explain variations in the real exchange rate. Unlike the FEER method, the BEER takes account of the impact of external exchange rate imbalances (Bénassy-Quéré, 2008).

When all variables in an econometric model admit cross-sectional dependence, the best approach is to estimate this regression model using the Driscoll-Kraay (1998) method, which is robust to standard errors (Hoechle, 2007). In addition, we will mobilize Panel Corrected Standard Error (PCSE) and feasible generalized least squares (FGLS) methods to test the robustness of our results. This is because a popular Prais-Winsten estimation with the Panel Corrected Standard Error (PCSE), suggested by Beck and Katz (1995), has been carried out to offer efficiency and consistency.

2.2.1. Pesaran (2004) cross-sectional dependence test

Pesaran's (2004) cross-sectional dependence test is designed to study the dependence and independence between variables. Under the null hypothesis, there is cross-sectional independence and under the alternative hypothesis, there is cross-sectional dependence.

Table 3: Results of the Pesaran (2004) cross-sectional dependence test

Variables	CD-test	P-value	Corr	Abs (Corr)
Reer	3.84	0.000	0.068	0.215
Inf	36.02	0.000	0.642	0.654
m	34.64	0.000	0.617	0.617
Ir	4.37	0.000	0.078	0.216
Gdppc	45.38	0.000	0.809	0.826
Imp	6.03	0.000	0.108	0.294
Fdi	8.67	0.000	0.155	0.265
Exp	7.49	0.000	0.133	0.297

Source: Authors based on Stata14 software

Analysis of this table reveals that all the variables in the study are cross-sectionally dependent, as shown by the P-values, which are all less than 1%.

3. Results

3.1. Analysis of the determinants of the real exchange rate in the franc zone

3.1.1. Analysis of the determinants of the real exchange rate using the Driscool-Kraay method in the franc zone

The estimation of the Reer model by the Driscool-Kraay method in the Franc zone gives an R^2 of 0.0532 and an F-Stat probability equal to zero for model 07. This shows that it is well specified and globally significant. This table shows that, with the exception of the coefficient on the exports variable, which is not significant, all the other variables are significant at the 1% level for inflation, the money supply, imports and foreign direct investment; significant at

the 10% level for the interest rate, and significant at the 5% level for the coefficient on the gross domestic product per capita variable.

The economic interpretation allows us to check whether our results are consistent with economic theories, by relying more on the results of the estimates of the equation for the regression of the real effective exchange rate on the explanatory variables of our model.

Table 4: Estimation of the Reer model using the Driscool-Kraay method in the franc zone

Vbles	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Imf	-0.0461*** (0.00)	-0.0499*** (0.00)	-0.0484*** (0.00)	-0.0388*** (0.00)	-0.0432*** (0.00)	-0.0433*** (0.00)	-0.0434*** (0.00)
m		-0.0463*** (0.00)	-0.0437*** (0.00)	-0.0476*** (0.00)	-0.0535*** (0.00)	-0.0513*** (0.00)	-0.0513*** (0.00)
Ir			0.1189* (0.09)	0.1291* (0.07)	0.1307* (0.06)	0.1310* (0.06)	0.1314* (0.06)
Gdppc				0.3476*** (0.00)	0.3245*** (0.00)	0.3202*** (0.00)	0.3328** (0.01)
Imp					0.0310*** (0.00)	0.0307*** (0.00)	0.0308*** (0.00)
Fdi						$-1.61e^{-08}$ (0.55)	$-1.61e^{-08}$ *** (0.55)
Exp							1.11^{e}-10 (0.78)
Cons	5.9756*** (0.00)	6.9505*** (0.00)	6.5106*** (0.00)	3.1812*** (0.00)	2.5144** (0.02)	2.5260** (0.01)	2.4019 (0.1)
Prob (F-Stat)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R^2	0.0139	0.0282	0.0389	0.0427	0.0524	0.0532	0.0532
Obs	450	450	450	450	450	450	450
Pays	15	15	15	15	15	15	15

Source: Author using Stata14 software

The values in brackets represent the P-values (probabilities) of the various coefficients. *, **, ***; represent significance at 10%, 5% and 1% respectively.

Inflation has a negative and significant effect at the 1% threshold on the real effective exchange rate in the franc zone. Thus, an increase in consumer prices of one unit would lead to a devaluation of the real effective exchange rate of 4.34% (column 7). To explain this result, we will hypothesize that there is a price differential in favor of the FTAs relative to their trading partners. On this basis, the currency with the highest inflation rate will then lose its value and depreciate on the Forex market (the foreign exchange market). This result is not compatible with the work of Combey & Nubukpo (2010), who emphasized that in a fixed exchange rate regime, inflation contributes to the loss of competitiveness and the overvaluation of the exchange rate.

The money supply has a negative and significant effect at the 1% threshold on the real effective exchange rate in the franc zone. Thus, an increase of one unit in the quantity of money in circulation would lead to a depreciation of the real effective exchange rate of 5.13%. In reference to the monetarist explanation of inflation given by Milton Friedman

(1952), the increase in the money supply will lead to inflation and this will lead to a depreciation of the FTA currency and consequently to a fall in the exchange rate. This result is consistent with the work of Alagided and Ibrahim (2017) who found that the money supply is negatively and significantly associated with the exchange rate. In contrast, Insah and chairak (2013) instead reported a positive association for money supply and the real effective exchange rate.

The interest rate has a positive and significant effect at the 10% threshold on the real effective exchange rate in the franc zone. Thus, an increase in the interest rate in the franc zone of one unit would lead to an appreciation of the real effective exchange rate of 13.14%. This result suggests that higher interest rates offer a higher return to lenders, which generally attracts foreign capital and causes an overvaluation of the exchange rate. Lower interest rates often encourage lenders to move their capital to a country with a higher interest rate, which can lower the value of the currency.

Gross domestic product per capita has a positive and significant effect at the 5% threshold on the real effective exchange rate in the franc zone. An increase in gross domestic product per capita of one unit would increase the real effective exchange rate by 33.28%. This result shows that if GDP growth is weak, the currency can lose value. Similarly, if demand for products exceeds supply, the exchange rate will generally rise. For example, in June 2023, when the press reported that the US had grown at an annualized rate of 2.0% in the third quarter (compared with the 0.6% forecast), the announcement immediately boosted the US dollar. However, this result is in line with Adusei and Gyapong (2017) where gross domestic product is a key forecaster of the exchange rate. Furthermore, MacDonald and Ricci (2003) in their work, estimate the Gdp have a positive influence on the real exchange rate in South Africa.

Imports have a positive and significant effect at the 1% threshold on the real effective exchange rate in the franc zone. Thus, an increase in imports of one unit would lead to an increase in the real effective exchange rate of 3.08%. This result is explained by the fact that imported goods, invoiced in the exporter's currency, are more expensive in the event of a devaluation of the importer's currency. This result is consistent with the work of M'hamed and Dahou (2021), who showed that an appreciation of the dinar against the dollar should lead to an increase in imports. Furthermore, this same result contradicts the work of Boucekkine et al, (2015) according to whom it is widely recognized that a depreciation of the dinar is likely to simply increase the price of goods from the main partners, namely the two euro and dollar zones, China, Turkey and other partner countries.

Foreign direct investment has a negative and significant effect at the 1% threshold on the real effective exchange rate in the franc zone. Thus, an increase in foreign direct investment leads to a depreciation of the real effective exchange rate. This result can be explained by the fact that the inflow of Fdi can reduce the level of competitiveness of the recipient country and have a negative impact on the exchange rate. This result is consistent with the work of Alagided and Ibrahim (2017) who found that Fdi inflows have a negative impact on the real effective exchange rate.

3.1.2. Analysis of the determinants of the real exchange rate using the Standard Error Adjusted Panel method in the franc zone

To analyze sensitivity, we will use the Panel Corrected Standard Error (PCSE) method, which has enabled us to test the robustness of our results. With the exception of Fdi and exports, the other variables in our econometric model have a significant influence on the real effective exchange rate in the franc zone.

Table 5: Estimation of the Reer model using the Panel Corrected Standard Error (PCSE) method in the Franc zone

Vbles	1	2	3	4	5	6	7
Imf	-0.0461*** (0.00)	-0.0499*** (0.00)	-0.0484*** (0.00)	-0.0388*** (0.00)	-0.0432*** (0.00)	-0.0433*** (0.00)	-0.0434*** (0.00)
m		-0.0463*** (0.00)	-0.0437*** (0.00)	-0.0476*** (0.00)	-0.0535*** (0.00)	-0.0513*** (0.00)	-0.0513*** (0.00)
Ir			0.1189** (0.04)	0.1291** (0.03)	0.1307** (0.03)	0.1310** (0.03)	0.1314** (0.03)
Gdppc				0.3476*** (0.00)	0.3245** (0.01)	0.3202*** (0.00)	0.3328*** (0.00)
Imp					0.0310*** (0.00)	0.0307*** (0.00)	0.0308*** (0.00)
Fdi						$-1.61e^{-08}$ (0.55)	$-1.61e^{-08}$ (0.55)
Exp							$1.11e^{-10}$ (0.91)
Cons	5.9756*** (0.00)	6.9505*** (0.00)	6.5106*** (0.00)	3.1812*** (0.00)	2.5144** (0.02)	2.5260** (0.01)	2.4019* (0.06)
Prob (Chi2-Stat)	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R^2	0.0139	0.0282	0.0389	0.0427	0.0524	0.0532	0.0532
Obs	450	450	450	450	450	450	450
Pays	15	15	15	15	15	15	15

Source: Author using Stata14 software.
The values in brackets represent the P-values (probabilities) of the various coefficients. *, **, ***; represent significance at 10%, 5% and 1% respectively.

However, making a comparison between different zones (UEMOA, CAEMC and COMORES) allows us to take into account the heterogeneity of our panel.

3.2. Analysis of the determinants of the real exchange rate in the WAEMU zone

3.2.1. Analysis of the determinants of the real exchange rate using the Driscool-Kraay method in the WAEMU zone

The estimation of the Tcer model by the Driscool-Kraay method in the WAEMU zone gives an R^2 of 0.0532 and an F-Stat probability equal to 0.0000% for model 07. This table shows that in the WAEMU zone, with the exception of the coefficients of the variables inflation, foreign direct investment and imports, which are insignificant, all the other variables

are significant at the 1% threshold for the money supply, gross domestic product per capita and exports, and significant at the 5% threshold for interest rates.

Table 6: Estimation of the Reer model using the Driscool-Kraay method in the WAEMU zone

Vbles	1	2	3	4	5	6	7
Imf	-0.0698*** (0.00)	-0.0872*** (0.00)	-0.0861*** (0.00)	-0.0395** (0.02)	-0.0325* (0.07)	-0.0324* (0.07)	-0.0254 (0.11)
m		-0.1366*** (0.00)	-0.1361*** (0.00)	-0.1502*** (0.00)	-0.1253*** (0.00)	-0.1236*** (0.00)	-0.1262*** (0.00)
Ir			0.0882 (0.18)	0.1105* (0.06)	0.1135* (0.06)	0.1137* (0.06)	0.1249** (0.03)
Gdppc				1.4034*** (0.00)	1.3743*** (0.00)	1.3705*** (0.00)	2.0859*** (0.00)
Imp					-0.0563* (0.09)	-0.0574* (0.09)	-0.0483 (0.16)
Fdi						$-6.96e^{-09}$ (0.19)	$-6.36e^{-09}$ (0.24)
Exp							$3.66e^{-09}$*** (0.00)
Cons	6.7883*** (0.00)	10.2171*** (0.00)	9.9543*** (0.00)	-3.5066 (0.43)	-2.0959 (0.59)	-2.0634 (0.60)	-9.2899** (0.02)
Prob (F-Stat)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R^2	0.045	0.0282	0.0389	0.0427	0.0524	0.0532	0.0532
Obs	240	240	240	240	240	240	240
Pays	8	8	8	8	8	8	8

Source: Author using Stata14 software
The values in brackets represent the P-values (probability) of the various coefficients. *, **, *** represent significance at 10%, 5% and 1% respectively.

3.2.2. Analysis of the determinants of the real exchange rate using the Corrected Standard Error Panel method in the WAEMU zone

Furthermore, when analyzing sensitivity, the estimation of the Reer model using the Panel Corrected Standard Error method in the WAEMU zone gives an $R^2$of 0.3059 and a Chi2-Stat probability equal to 0.0000% for model 07. This shows that the model is well specified. This table shows that in the WAEMU zone, with the exception of the coefficients of the variables inflation, foreign direct investment and interest rates, which are insignificant, all the other variables are significant at the 1% level for money supply, gross domestic product per capita and exports, and significant at the 5% level for imports.

Table 7: Estimation of the Reer model using the Panel Corrected Standard Error (PCSE) method in the WAEMU zone

Vbles	1	2	3	4	5	6	7
Imf	-0.0698*** (0.00)	-0.0872*** (0.00)	-0.0861*** (0.00)	-0.0395* (0.06)	-0.0325 (0.13)	-0.0324* (0.07)	-0.0254 (0.17)

m		-0.1366*** (0.00)	-0.1361*** (0.00)	-0.1502*** (0.00)	-0.1253*** (0.00)	-0.1236*** (0.00)	-0.1262*** (0.00)
Ir			0.0882 (0.28)	0.1105 (0.19)	0.1135 (0.18)	0.1137* (0.06)	0.1249 (0.15)
Gdppc				1.4034*** (0.00)	1.3743*** (0.00)	1.3705*** (0.00)	2.0859*** (0.00)
Imp					-0.0563** (0.02)	-0.0574* (0.09)	-0.0483** (0.03)
Fdi						$-6.97e^{-09}$ (0.19)	$-6.36e^{-09}$ (0.72)
Exp							$3.66e^{-09}$*** (0.00)
Cons	6.7883*** (0.00)	10.2171*** (0.00)	9.9543*** (0.00)	-3.5066 (0.18)	-2.0959 (0.45)	-2.0634 (0.45)	-9.2899*** (0.00)
Prob (Chi2-Stat)	0.0022	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R^2	0.0452	0.2008	0.2079	0.2758	0.2884	0.2887	0.3059
Obs	240	240	240	240	240	240	240
Pays	8	8	8	8	8	8	8

Source: Author using Stata14 software
The values in brackets represent the P-values (probabilities) of the various coefficients.
*, **, *** represent significance at 10%, 5% and 1% respectively.

However, it is important to note that estimating the Reer model using the Driscool-Kraay method allows us to have the same number of significant and non-significant variables when estimating the same model using the Standard Error Adjusted Panel method. However, it should be noted that the variable imported using the Driscool-Kraay method is insignificant and subsequently becomes significant when the method is changed (Standard Error Adjusted Panel). Similarly, the interest rate variable, which is significant using the Driscool-Kraay method, becomes insignificant when the model is estimated using the Standard Error Adjusted Panel method.

Table 7 shows that of the seven (07) variables used, four (04) are significant (money supply, gross domestic product per capita, imports and exports) and four (03) are insignificant (inflation, interest rate and foreign direct investment). It can therefore be said that the real effective exchange rate in the WAEMU zone using the Panel Corrected Standard Error (PCSE) method is influenced by the money supply, gross domestic product per capita, imports and exports.

3.3. Analysis of the determinants of the real exchange rate in the CAEMC zone

3.3.1. Analysis of the determinants of the real exchange rate using the Driscool-Kraay method

Table 8: Estimation of the Reer model using the Driscool-Kraay method in the CAEMC zone

Vbles	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Imf	0.0050	-0.0041	-0.0041	-0.0054	-0.0191	-0.0180	-0.0182

	(0.69)	(0.74)	(0.74)	(0.68)	(0.25)	(0.17)	(0.18)
m		-0.0200 (0.49)	-0.0205 (0.53)	-0.0227 (0.48)	-0.0121 (0.69)	-0.0148 (0.60)	-0.0288 (0.43)
Ir			-0.0075 (0.93)	-0.0068 (0.93)	0.0235 (0.73)	0.0051 (0.94)	0.0409 (0.48)
Gdppc				0.1035 (0.37)	0.0657 (0.71)	-0.1425 (0.54)	0.1593 (0.56)
Imp					-0.1233*** (0.00)	-0.1282*** (0.00)	0.1450*** (0.00)
Fdi						-0.0230** (0.04)	-0.0224* (0.08)
Exp							-0.0219 (0.19)
Cons	4.2979*** (0.00)	4.6243*** (0.00)	4.6548*** (0.00)	3.6806** (0.01)	-0.4975 (0.75)	1.6016 (0.48)	-0.9352 (0.69)
Prob (F-Stat)	0.6902	0.7669	0.8709	0.8296	0.0000	0.0000	0.0000
R^2	0.0001	0.0011	0.0011	0.0014	0.3114	0.3235	0.3357
Obs	180	180	180	180	180	180	180
Pays	6	6	6	6	6	6	6

Source: Author using Stata14 software

The values in brackets represent the P-values (probabilities) of the various coefficients. *, **, ***; represent significance at 10%, 5% and 1% respectively.

Table 8 shows that, using the Driscool-Kraay method in the CAEMC zone, of the seven (07) variables used, five (05) are insignificant (inflation, money supply, interest rate, gross domestic product per capita and exports) and only two (02) of the seven variables are significant (imports and foreign direct investment). This result shows that the real effective exchange rate in the CAEMC zone is influenced by imports and foreign direct investment.

3.3.2. Analysis of the determinants of the real exchange rate using the Standard Error Corrected Panel method in the CAEMC zone

The estimation of the Reer model by the Standard Error Corrected Panel method in the CAEMC zone gives an R^2 of 0.3357 and a Chi2-Stat probability equal to 0.0000% for model 07. This shows that the model is well specified. This table shows that in the CAEMC zone, with the exception of the coefficients of the import and export variables, which are significant at the 1% and 5% thresholds respectively, all the other variables are insignificant.

Table 9: Estimation of the Reer model using the Corrected Standard Error Panel method in the CEMAC zone

Vbles	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Imf	0.0050 (0.79)	0.0041 (0.83)	0.0041 (0.83)	-0.0054 (0.78)	-0.0191 (0.40)	-0.0180 (0.42)	-0.0182 (0.43)
m		-0.0200 (0.30)	-0.0205 (0.35)	-0.0227 (0.30)	-0.0121 (0.63)	-0.0148 (0.59)	-0.0288 (0.34)

Ir			-0.0075 (0.93)	-0.0068 (0.94)	0.0235 (0.78)	0.0051 (0.95)	0.0409 (0.62)
Gdppc				0.1035 (0.28)	0.0657 (0.73)	-0.1425 (0.49)	0.1593 (0.55)
Imp					0.1233*** (0.00)	0.1282*** (0.00)	0.1450*** (0.00)
Fdi						-0.0230 (0.11)	-0.0224 (0.11)
Exp							0,0219** (0.04)
Cons	4.2979*** (0.00)	4.6243*** (0.00)	4.6548*** (0.00)	3.6806*** (0.00)	-0.4975 (0.80)	1.6016 (0.45)	-0.9352 (0.74)
Prob (Chi2-Stat)	0.7969	0.5885	0.7774	0.7277	0.0000	0.0000	0.0000
R^2	0.0001	0.0011	0.0011	0.0014	0.3114	0.3235	0.3357
Obs	180	180	180	180	180	180	180
Pays	6	6	6	6	6	6	6

Source: Author using Stata14 software

The values in brackets represent the P-values (probabilities) of the various coefficients.

*, **, *** represent significance at 10%, 5% and 1% respectively.

Table 9 shows that of the seven (07) variables used, five (05) are insignificant (inflation, money supply, interest rate, gross domestic product per capita and exports) and only two (02) are significant (imports and foreign direct investment). This result shows that the real effective exchange rate in the CAEMC zone is influenced by imports and foreign direct investment.

In sum, we find that only the coefficient on the import variable remains significant when the Reer model is estimated using the Driscool-Kraay method and the Panel Corrected Standard Error (PCSE) method respectively in the two zones (WAEMU and CAEMC). It is therefore important to note that estimating the Reer model using both the Driscool-Kraay method and the Panel Corrected Standard Error (PCSE) method in the two zones allows us to have the same number of significant and non-significant variables when we change the estimation model. However, it should be noted that the variable imported using the Driscool-Kraay method is insignificant but subsequently becomes significant when the method is changed (Panel Corrected to Standard Error). Similarly, the interest rate variable, which is significant using the Driscool-Kraay method, becomes insignificant when the model is estimated using the Panel Corrected Standard Error (PCSE) method.

3.3. Analysis of the determinants of the real exchange rate using the Generalized Least Squares (GLS) method in Comoros

The estimation of the Reer model by the Generalized Least Squares (GLS) method in Comoros gives an R^2 of 0.5366 and an F-Stat probability equal to 0.0093% in column 07. This shows that the model is well specified. This table shows that in Comoros, except for the

coefficients of the interest rate, gross domestic product per capita and import variables, which are significant at the 5%, 5% and 1% thresholds respectively, all the other variables are insignificant.

Table 10: Estimation of the Reer model using the Generalized Least Squares (GLS) method in Comoros

Vbles	1	2	3	4	5	6	7
Imf	-0.0159 (0.22)	-0.0166 (0.21)	-0.0200 (0.10)	-0.0174 (0.17)	-0.0181 (0.13)	-0.0183 (0.14)	-0.0179 (0.15)
m		0.0105 (0.49)	0.0176 (0.29)	-0.0077 (0.76)	-0.0051 (0.79)	-0.0036 (0.85)	0.0167 (0.54)
Ir			-0.0379** (0.04)	-0.0389** (0.04)	-0.0405 (0.01)	-0.0402** (0.01)	-0.0397** (0.02)
Gdppc				0.9558 (0.21)	1.6744 (0.00)	1.5850** (0.02)	1.4339** (0.03)
Imp					-0.1457*** (0.00)	-0.1484*** (0.00)	-0.1528*** (0.00)
Fdi						0.0472 (0.70)	-0.0471 (0.70)
Exp							0.0920 (0.28)
Cons	9.1239*** (0.00)	8.9416*** (0.00)	9.0811*** (0.00)	1.1159 (0.85)	-1.1917 (0.80)	-0.3755 (0.94)	1.5816*** (0.77)
Prob (F-Stat)	0.0000	0.0000	0.0000	0.0000	0.0003	0.0013	0.0093
R^2	0.6728	0.6634	0.7745	0.7227	0.5972	0.5840	0.5368
Obs	30	30	30	30	30	30	30
Pays	1	1	1	1	1	1	1

Source: Author using Stata14 software

Values in brackets represent the P-values (probabilities) of the various coefficients. *, **, ***; represent significance at 10%, 5% and 1% respectively.

Table 10 shows that of the seven (07) variables used, five (04) are insignificant (inflation, money supply, foreign direct investment per capita and exports) and three (03) are significant (interest rate, gross domestic product and imports). This result shows that the real effective exchange rate in the Comoros zone is influenced by the interest rate, gross domestic product per capita and imports.

4. Similarities and divergences of the different variables between the three zones

We will look at the specific features of each sub-region

4.1. Similarities

The estimation of the Reer model by the Driscool-Kraay method in the two zones (WAEMU and CAEMC) and the generalized least squares (GLS) method in the Comoros, have in common the variable inflation which is insignificant. Furthermore, by analyzing the sensitivity, the estimation of the Reer model by the Panel Corrected Standard Error method in the two zones (WAEMU and CAEMC), and by using the generalized least squares (GLS) method in the Comoros, these three zones also have in common the inflation and foreign

direct investment variables, which are all insignificant in these three zones. Furthermore, only the imports variable is significant in all three zones. Furthermore, the variables gross domestic product per capita are significant in the WAEMU zone (D-K and PCSE methods) and in Comoros (GLS method).

4.2. Discrepancies

Here, the estimation of the Tcer model by the Driscool-Kraay method in the two zones (WAEMU and CAEMC) and by the generalised least squares (GLS) method in the Comoros shows that of the seven variables used, three (inflation, imports and foreign direct investment) are insignificant in the WAEMU zone compared with five (inflation, money supply, interest rate, gross domestic product and exports) which are also insignificant in the CAEMC zone and in the Comoros, money supply, interest rate, gross domestic product and exports) are also insignificant in the CAEMC zone and in Comoros, four (inflation, money supply, foreign direct investment and exports) of the seven variables are also insignificant. Speaking of the coefficients of the variables that are significant out of the seven used, we have four variables (money supply, interest rate, gross domestic product and exports) in the WAEMU zone, two (imports and foreign direct investment) variables in the CAEMC zone and three (interest rate, gross domestic product and imports) in the Comoros.

However, when we change the estimation method (estimation of the Reer model by the Panel Corrected Standard Error method) we find that of the seven variables used the same variables are insignificant (inflation, interest rate and foreign direct investment) in both zones and subsequently significant in these same zones (import and export). In sum, we can therefore say that by estimating the Reer model using the Driscool-Kraay method and the Panel Corrected Standard Error method, only the coefficient on the import variable is significant in both the WAEMU and CAEMC zones.

5. Conclusion

Although the existing literature on the determinants of the real effective exchange rate is abundant, no study has focused specifically on the African countries of the Franc Zone, whose currencies are still pegged to the euro, despite the end of the gold standard in 1971. This specificity led us to set ourselves the objective of analyzing the determinants of the real effective exchange rate in the Franc Zone countries. The use of the Driscol-Kraay method on panel data from 15 Franc Zone countries, covering the period 1990-2019 revealed that inflation, money supply, the interest rate, gross domestic product per capita, imports and direct investment are the main determinants of the real effective exchange rate in the franc zone. Furthermore, the use of the Panel Corrected Standard Error method revealed that our results are robust. In addition, the analysis of the specificities of each country or group of countries made it possible to take into account the heterogeneity of the panel. Consequently, the central banks of each country or group of countries must assess the consequences of the exchange rate when designing their monetary policies. Moreover, each government should also take into account the repercussions on the exchange market of its macroeconomic choices.

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