



MANAGEMENT OF THE CFA FRANC: WHAT ARE THE FUNDAMENTALS OF THE REAL EXCHANGE RATE IN WEST AFRICAN ECONOMIC AND MONETARY UNION (WAEMU)?

 Kwami Ossadzifo
Wonyra¹⁺
Honore Tenakoua²

¹FaSEG-Universite de Kara, Togo.

Email: wonyra.ossa@gmail.com Tel: (+228)90013209

² Chef du Service de la Brigade de Verification N°2 de la Direction des Moyennes Entreprises du Centre III/ Ouagadougou, Burkina Faso.



(+ Corresponding author)

ABSTRACT

Article History

Received: 6 December 2019

Revised: 13 January 2020

Accepted: 14 February 2020

Published: 16 March 2020

Keywords

Fundamentals

Real exchange rate

CFA

PMG

WAEMU.

JEL Classification:

E52; F15; F31.

Identifying the fundamentals of the real exchange rate of the CFA franc in West African Economic and Monetary Union (WAEMU) is the main objective of this paper. To achieve this, we used panel data over a period from 1984 to 2014. To achieve this objective, we use the Pooled Mean Group, inspired by the work of Pesaran, Shin, and Smith (1999) with data from secondary sources from the World Bank and the International Monetary Fund. The results obtained show that investment, government spending, trade openness and balance significantly influence the real exchange rate of the long-term CFA franc in WAEMU. With regard to the short-term relationship, the results show that only productivity and the trade balance are the fundamentals that significantly influence the real exchange rate of the CFA franc. It is then necessary to find a solution to this extroversion of WAEMU economies, which solution would be the promotion of the import substitution policy. A policy should be put in place to enable our economies to benefit from trade liberalization. This involves promoting exports of high value-added products in order to improve the external position of economies and to address the instability of commodity prices on which developing country exporters of primary goods depend.

Contribution/Originality: This study contributes to the existing literature by Identifying the fundamentals of the real exchange rate of the CFA franc in West African Economic and Monetary Union (WAEMU).

1. INTRODUCTION

Recent debates on structural adjustments to macroeconomic stabilization have accentuated the crucial role of the exchange rate in promoting exports and driving towards the optimal pathways of production and employment. It is therefore obvious that keeping the value of its currency at an appropriate level becomes a fundamental objective since, an overvaluation would result in the loss of competitiveness of the economy vis-à-vis the rest of the world. The African countries of the franc zone, through their history, have inherited a fixed exchange rate regime since their colonial past. Thus these countries saw their currency match the French Franc (FF) which was the currency of their mother country. In fact, in 1948, 1 FF was equivalent to 50 CFA francs; in 1994, this fixed parity was modified and 1 FF was worth 100 F CFA, a devaluation of 100% in order to take into account the internal and external imbalances of the countries of the franc zone in the face of the impotence of the solutions proposed by the

Structural Adjustments Programs (SAPs) in the 1980s. The 1994 devaluation, the only African franc zone (PAZF) devaluation was considered an important step in strengthening price competitiveness and economic activity.

However, the expected effects of this adjustment did not meet the expectations of economic recovery in these countries and did not last in time. Thus, according to a study conducted by [Djoulfelkit-Cottenet \(2006\)](#); [Djoulfelkit-Cottenet \(2007\)](#) the WAEMU Real Exchange Rate (RER) appreciated by 13.4% between 1994 and 2004 (for the whole CFA franc zone, its appreciation is 12.7%) compared to its post-devaluation level in 1994. From 2005 to 2006, it declined by -0.2% for WAEMU (-0.6% for the CFA franc zone). In total, between 1994 and 2006, the WAEMU zone recorded an appreciation of the RER corresponding to a loss of competitiveness of around 22% (21% for the CFA franc zone). For [Kiema, Nubukpo, and Sanou \(2011\)](#) the gains in competitiveness acquired during this devaluation of 1994 completely disappeared in the years 2002 - 2003. Since January 1st 1999, the FF became the Euro and the new parity becomes 1 Euro against 655,957 CFA francs. Thus, with the advent of the Euro, in January 1999, the CFA franc is now pegged to the euro. The value of the CFA franc in the international markets depends on that of the Euro. The evidence of the fixed CFA franc is that the PAZF do not have control of their exchange rate policy and are thus vulnerable to fluctuations in world prices. This makes the level of PAZF export earnings dependent on fluctuations in international currencies. In this logic one could believe that the recurrent phases of distortion of the real exchange rate in the WAEMU are partly attributable to the fluctuations of the Euro against the dollar and vice versa.

In 2002, the CFA franc was appreciated again in reference to the euro, which in turn was more appreciated than 30% against the US dollar. Still Better, between 2000 and 2010, the dollar has indeed lost 43% of its value against the euro, and therefore against the CFA franc, which puts upward pressure on the CFA franc. [Coudert, Couharde, and Mignon \(2011\)](#) point out that the anchor currency is not neutral: their equilibrium exchange rate estimates for these economies show that the CFA franc tends to be overvalued in periods when the euro is strong. In addition, the recent financial crisis has seen the euro being appreciated considerably and, in turn, an appreciation of the CFA franc. Thus, considering the trade structure of the WAEMU countries, which is essentially based on the export of commodities whose prices are subject to strong fluctuations, a strong currency would then be considered as an export tax, which makes the PAZF less competitive. In the countries of the franc zone and especially in the WAEMU countries, this phenomenon of overvaluation is all the more acute since export sectors are often vital because of the narrowness of their internal market, the low diversification of their production and the weakness of their human capital and technological potential. It therefore appears that for these countries, growth depends largely on export sectors, which are the main source of foreign exchange, the main source of government revenue, and are the main attractive sectors of FDI ([Elbadawi, 1999](#)).

Many authors investigate, recently, the fundamentals of real effective exchange rate in several areas. [Madouni \(2014\)](#) examines the Equilibrium real exchange rate of the Algerian dinar from 1971 to 2012. He uses a cointegration method in order to test the long-run association between the real effective exchange rate, on the one hand, and oil prices (as a proxy variable for the terms of trade), government expenditure, relative productivity, and the openness. [Eslamloueyan and Kia \(2015\)](#) develop and estimate a model of the real exchange rate for oil-producing countries in the Middle East and North Africa (MENA) for the period 1985–2009. [Altamony, Al-Salti, Gharaibeh, and Elyas \(2016\)](#) investigate the long-run fundamental determinants of the real effective exchange rate (REER) of the Bahraini dinar using annual time series data mostly collected from economic indicators of Trading Economics 2016 and UNCTAD stat 2016.

The WAEMU countries, having lost the monetary policy instrument due to the fixed exchange rate regime with respect to Mundell's incompatibility triangle, have at their disposal only the instrument of fiscal policy. This fiscal policy suffers from inefficiency in the face of the enormous stakes of growth, development and the reduction of poverty. It emerges that the WAEMU countries do not have a real economic policy instrument that can help to get out of this trap of economic difficulties. These difficulties are reinforced by a currency that tends to appreciate (even

if the exchange rate is subject to reflection given) the evolution of the global economic environment and especially the poor health of the stowage currency of the CFA franc. Moreover, the debt crisis in the euro area since 2011 leads to the issue of the devaluation of the CFA franc. Recent debates about an imminent devaluation or not obviously create a state of alert for economic agents. Under these conditions, strong speculations can emerge. Thus, economic agents are seeking to exchange the CFA franc against foreign currencies including the euro.

However, disregarding these debates around the devaluation, a more in-depth analysis of the situation of the CFA franc should generate renewed interest. If since the devaluation of 1994, it is the debt crisis in the euro area that foments once again this crucial controversy of the devaluation, then it is wise to question the fundamentals of the real exchange rate of the CFA franc. Indeed, this controversy can be justified by the possible effects of a devaluation on the macroeconomic and social framework of the countries of the franc zone and this because of the fragility of their economies. This is also due to their inability to satisfy so much of their demand for domestic consumption. What are then the fundamentals of the real equilibrium exchange rate of the CFA franc in WAEMU? The purpose of this paper is to identify the economic fundamentals that explain the behavior of the Real Equilibrium Exchange Rate (REER) in WAEMU. To achieve this objective, we have used panel data over a period from 1984 to 2014. The results obtained using the Pooled Mean Group (PMG) method show that investment, government expenditure, trade openness and balance significantly influence the real exchange rate of the long-term CFA franc in WAEMU. With regard to the short-term relationship, the results show that only productivity and the trade balance are the fundamentals that significantly influence the real exchange rate of the CFA franc.

The rest of the paper is organized as follows. The next section provides a survey of the existing literature, followed by a discussion of the methodology in Section 4. The results and discussion are presented in Section 5. Section 6 concludes the work.

2. LITERATURE REVIEW

2.1. *The Exchange Rate Policy in Waemu*

The CFA franc zone is made up of three zones, including WAEMU, MECCAC and Comoros. These three zones have central banks. The CFA franc is a financial and monetary organization, under the supervision of France, which relies on African institutions, Central Bank of West African Countries (CBWAC) for WAEMU; the Central Bank of Central African Countries (CBCAC) for Monetary of Economic Community of Central African Countries (MECCAC) and the Central Bank of Comoros (CBC) for the Comoros. The CFA franc is based on four main principles: centralization of reserves; foreign exchange to the French public treasury; fixity of the CFA / FF franc parity (now, this is the CFA / euro franc); free convertibility of the CFA franc to the euro; free movement of capital between France and the African countries of the Franc zone (PAZF).

To these four principles is added the control of the flow of currency, the freedom of transfer of the monetary signs, the adoption of a common regulation of exchange. It should be noted that the strict control of foreign exchange flows (incoming and outgoing) makes it possible to monitor their impact on inflation and the overall movement of capital. Note that, the freedom of transfer of the monetary signs was at the origin of the creation of the zone Franc. Nowadays, this principle has been repealed because central banks only accept the currency of the France Bank and not those issued by the other sister central banks. This suppression of convertibility was introduced in the aftermath of capital leaks observed within the currency areas and this measure prevents speculation. As for the principle of free convertibility of the CFA franc and the free movement of capital, it should be noted that it applies to the PAZF and to France and vice versa. However, it does not concern exchanges between the three CFA zones. This principle facilitates French investment in Africa, the repatriation of capital, the flight of capital from Africa to France and the import of raw materials by France. In this scheme, the idea that the CFA franc hinders the intensification of intra - zone trade cannot be refute. In addition to these cardinal principles, there is also French participation in the management bodies of central banks.

2.2. Characteristics and Functioning Mechanisms of Exchange Rate Policy in WAEMU

The exchange rate policy in WAEMU emanates from the monetary cooperation agreement between France and the WAEMU countries signed in Dakar on December 4, 1973. This agreement establishes the general framework for economic and financial cooperation between France and the countries of AEMU. The main characteristics of this monetary union are as follows: the fixed parity between the CFA franc and the French franc; Central Bank of West African Countries (CBWAC) advances to National Treasuries are limited to 20% of last year's tax revenue; foreign currency reserves are centralized by the CBWAC; each country is obliged to give up to 65% of its foreign currency to it; the CBWAC's foreign exchange reserves are deposited in an operating account opened with the French Treasury; the French Treasury undertakes to make available to the CBWAC the amount of currency it would need in case of difficulty. Once the characteristics of the exchange rate policy have emerged, what are its operating mechanisms?

The WAEMU's exchange rate policy is based on the principles resulting from the agreements between France and the PAZF as described above. However, for the purposes of this study, we will focus on two operating principles of the CFA franc. This is the principle of the centralization of foreign exchange reserves via transaction account and the fixed parity between the CFA franc/the euro, which are in fact the two principles relating to the management of the exchange rate policy of the WAEMU. Note that since 2005, this rate has been revised downward. From now on, 50% of the foreign exchange reserves must be stored on the transaction account in France in about 65%. This decision of lowering was taken on July 23, 2004 in Dakar during a meeting of two parties.

The centralization of foreign exchange reserves is the provision of the institutional framework that has the greatest impact on foreign exchange transactions. The WAEMU states pledge to raise 50% of their foreign exchange reserves in the CBWAC's operating account with the French Treasury. Residents are required to register with authorized intermediaries, capital movements and import and export transactions of goods through financial institutions. Each Central Bank has a French Treasury operation account and must deposit a portion of its currency reserves. These trading accounts are remunerated. The foreign exchange reserves pooled on the trading account can be used to finance the temporary deficit of certain members. What is the practical goal of setting up the operating account?

The objective of setting up the operating account in the terms of the CFA franc is to allow the PAZF to be able to finance without difficulty their import requirements for goods and services. Given the domiciliation of their Operating Account in the French Treasury, France undertakes without limitation to make available to PAZF foreign exchange necessary for the financing of their import needs. What are the limits of the operating mechanism of the CFA franc?

The operating mechanism of the CFA franc is subject to sharp criticism in the literature on the choice of exchange rate regimes specific to developing countries. Indeed, according to the operating mechanism of the operating account, the funds placed in "transaction accounts" generate interest each time the amount exceeds the import requirements of the African countries concerned. France remunerates the central banks in interest, after having made private placements. The paradox is that the interest paid to central banks is accounted for in the Public Aid for Development section. In addition, the effects of the functioning mechanism of the CFA franc are asymmetrical. The most sparing countries in the Franc zone can use the foreign exchange reserves of countries with more prudent management. In addition, according to [D'Almeida \(1998\)](#) the ease of obtaining the necessary foreign exchange for their import needs by the PAZF, leads these countries not to develop the productive sectors that can generate foreign exchange gains.

3. REAL EXCHANGE RATE: CONCEPTS AND MEASUREMENT

The Real Exchange Rate (RER) is a theoretical concept which has two broad definitions: the first comes from the theory of purchasing power parity (PPP) and the second, from the theory of international trade (Hinkle & Montiel, 1999). The first defines the external RCT of a given country as its nominal exchange rate (number of foreign currency units for a unit of national currency) corrected for the differential between its price level and that of other countries (ratio of prices, expressed in a common currency, abroad and in the country). The external RER thus measures the relative price of the same basket of goods, locally and abroad; it is similar to an indicator of external competitiveness. A relative increase in the price index in the country concerned corresponds to an assessment of the external RER. The second definition is derived from the Salter-Swan dependent economics theory and applies to small "price takers" countries, which is the case in many developing countries. It defines the so-called internal RER as the ratio within the same country of domestic prices of tradable and non-tradable goods internationally. This relative price is an indicator of internal competitiveness, ie internal incentives for an economy to produce tradable rather than non-tradable goods (under the law of the single price, internal competitiveness also automatically implies external competitiveness). An increase in the relative price of tradable goods corresponds to a depreciation of the internal RER. Whatever the definition used, the RER is a real indicator and not a monetary one.

There are generally two main theories of the Equilibrium Real Exchange Rate: the first approach is based on a two-sector inter-temporal general equilibrium model; it defines the equilibrium real exchange rate as the relative price of tradable versus nontradable. From a theoretical point of view, it is the most complete but is however complex to be implemented empirically. The second approach, which we will use in the context of this work, is more macroeconomic and defines the exchange rate as an indicator of competitiveness; its equilibrium level makes it possible to reach the external equilibrium while being compatible with the internal equilibrium. The empirical computation in this case is easier and relies on the most robust mechanisms inscribed in macro econometric models.

The concept of equilibrium real exchange rate is defined by Edwards (1989) and relates to certain aggregates (international capital flows, terms of trade, trade policy, level and composition of public expenditure, productivity progress ...). The equilibrium real exchange rate is thus determined solely by its fundamentals. On the other hand, the current real exchange rate also responds to short and medium term macroeconomic policy changes. When the current real exchange rate deviates significantly from its equilibrium path, it is referred to as a misalignment (under or over) of the real exchange rate. Such misalignment can be caused by inadequate macroeconomic policies (monetary/fiscal and exchange rate policies), most often leading to an overvaluation of the real exchange rate and, in so doing, a loss of price competitiveness.

In practice, the structural approach of the real exchange rate, in terms of the relative price of tradable versus non-tradable goods, does not coincide with the notion of the real exchange rate generally used by practitioners. These are more in keeping with the tradition of neo-Keynesian empirical modeling. They are therefore interested in the real exchange rate, not because of its ability to describe incentives to allocate resources between the tradable and non-tradable goods sectors, but because it is an indicator of competitiveness of a country and thus conditions its "external equilibrium". For example, the real exchange rate is most often used because it is an indicator of a country's competitiveness, which conditions the orientation of demand towards domestic or foreign production, and not because it reports on the allocation of domestic production capacity between tradable and non-tradable goods. The variable of interest is therefore simply the usual ratio of a global index of foreign prices to a comparable domestic index, both expressed in a common currency:

$$TCR = \frac{EP^*}{P} \quad (1)$$

Where E is the nominal exchange rate, P^* is the price of tradable goods and P is the non-tradable goods. The two notions of real exchange (macroeconomic and general equilibrium) are thus fundamentally different. They

can be related to each other, but not in a univocal way. More precisely, if α represents the share of non-tradable goods in the basket of domestic goods, the domestic price is written:

$$P = P_{ne}^\alpha P_e^{1-\alpha} \text{ and we can derive the price ratio } \frac{P_e}{P} = \left(\frac{P_e}{P_{ne}}\right)^\alpha = (TCR)^\alpha \quad (2)$$

Similarly, if β is the share of non-tradable goods in the foreign goods basket, we can write:

$$\frac{P_e^*}{P^*} = (TCR^*)^\beta \quad (3)$$

Assuming the verified single price law for all tradable goods, the relationship becomes:

$$\frac{P_e^*}{EP^*} = (TCR^*)^\beta \quad (4)$$

From these two relations, we can write the real exchange rate in terms of the ratio of foreign and domestic price indices:

$$\frac{EP^*}{P} = TCR^\alpha (TCR^*)^{-\beta} \quad (5)$$

It therefore appears that even in the case where the assumption of the law of the single price is verified for tradable goods, the two exchange rates maintain a simple relationship only if the relative price of tradable goods, foreign non-tradables remains constant. In this case, the ratio of domestic and foreign price indices is proportional (in logarithm) to the real exchange rate estimated as the relative price of tradable goods. Strictly speaking, the real foreign exchange rate (RER *) has no reason to remain constant.

The small country hypothesis nevertheless allows us to consider that the real foreign exchange rate is exogenous, so that by varying the two real exchange rates evolve in parallel. In practice, exporters' margin behavior and product differentiation in the context of imperfect competition are causing deviations from the single price law for tradable goods.

3.1. The Different Approaches to Calculating the Real Equilibrium Exchange Rate (REER)

The literature on the calculation of the ERTC offers several approaches including the traditional theories of Uncovered Interest Rate Parity (UIP) and Purchasing Power Parity (PPP) and recent approaches such as the FEER approach. (Fundamentals Equilibrium Exchange Rate, the UIEB approach (Underlying Internal - External Balance) and BEER (Behavior Equilibrium Exchange Rate) approach.

The RER motion analyzes began with PPP and UIP theories. However, the UIP approach is more informative on the variations of the RER but not on the level of the RER. This approach has not been successful in predicting RER motions, partly because the UIP estimate does not take into account possible changes in the RER equation (Saxegaard, Roudet, & Tsangarides, 2007). The PPP theory predicts that price levels will equalize when valued in the same currencies, suggesting that the ERER would be constant and equal to unity. Empirical work, having tested the theory of PPP, has not confirmed this theory (MacDonald, 2000; Rogoff, 1996).

This situation leads to the necessity of proposing a new approach. Thus, to explain the persistence of the shocks on the RER, it is possible to combine the two approaches (UIP and PPP) and to estimate the cointegration relationship between the relative prices and the nominal interest rate differential and the nominal exchange rate (Johansen & Juselius, 1992). This combination is recognized as the Capital Enhanced Equilibrium Exchange Rate (CEEER) approach, which has produced faster convergence of estimates than other PPA models.

Another popular approach used to estimate the RERT is that which highlights the internal and external balance. This is the UIEB approach (Underlying Internal-External Balance), also recognized as the approach to macroeconomic equilibrium (Edwards, 1989). This approach defines the REER as the rate that simultaneously satisfies the internal and external equilibrium. For the simultaneous equilibrium to be realized, the anticipated supply must be equal to the aggregate demand (the sum of the domestic demand and the trade balance), with a

REER playing the role of the relative price, the price which should be adjusted to ensure a balance between supply and demand.

The most commonly used variants of the UIEB approach are the FEER approach of [Edwards \(1989\)](#), [Williamson \(1994\)](#) and [Wren-Lewis \(1992\)](#) the DEER approach (Desired Equilibrium Exchange) and Stein's Natural Real Exchange Rate (NATREX) approach (1994).

Finally, a method dealing with short time horizons is the BEER approach associated with [Clark and MacDonald \(1999\)](#). These BEER approaches consist of modeling techniques that capture the movements of the RER over time and not just the movements of the short or long term equilibrium levels. This approach is largely empirically used with variables of obedience to represent the long-term fundamentals in the same way as the FEER approach.

As [Driver and Westaway \(2004\)](#) point out, there is not one definition of the RER. The choice of the approach depends on the subject of interest and in particular on the time horizon considered. In addition to the methodological issues (the definition and measurement of the REEC), the choice between the different approaches must be motivated by the subject of interest. The approaches to be used should differ according to the dynamics and the period of study considered.

4. EVIDENCE OF EMPIRICAL STUDIES ON EXCHANGE RATE FUNDAMENTALS

Recent developments in the equilibrium real exchange rate have brought renewed interest in estimating the real equilibrium exchange rate in the regional economic communities. [Kiema et al. \(2011\)](#) for their part, evaluated the impact of the devaluation of the CFA franc on the trade and production balance in the WAEMU countries. To achieve this, they calculate the misalignments of the real exchange rate of the CFA franc by estimating the relationship between the latter and its fundamentals. They use the econometric techniques of FMOLS (Full Modified Ordinary Least Square) and PMG (Pooled Mean Group). The results show that the competitiveness gain created by the 1994 devaluation was abolished in the years 2002-2003 and that currently the REER of the zone is globally overvalued with different degrees depending on the estimation technique used (1 to 9%).

[Ho and Ariff \(2011\)](#) report new findings from G-10 and Latin America on exchange rate dynamics on how non-parity factors influence exchange rates. By systematically retesting the model with high and low frequency data sets, they found both short and long-run behaviors. Using new econometric techniques (i.e., pooled time series panel regression) they found evidence that non-parity factors are significantly correlated with exchange rates, after controlling for parity factor effects.

[Ha and Pham \(2012\)](#) test the degree of misalignment of Viet Nam Dong (VND) by estimating equilibrium real effective exchange rate. Empirical findings of the study suggest that government expenditure, trade openness, net foreign assets, and domestic credit are significant determinants of the real effective exchange rate of VND. They suggest reducing nominal and real exchange rate gap, creating a stable exchange rate, narrowing misalignments, attracting the investors, and promoting long-run competitiveness of the economy as recommendations.

[Ajao and Igbekoyi \(2013\)](#) estimate and test the determinants of real exchange rate volatility in Nigeria for the period 1981-2008 using the ECM technique. Their co-integration analysis reveals the presence of a long term equilibrium association between the effective exchange rate and its determinants. Their findings explicitly reveal that government expenditures, interest rate movements, openness of the economy, and the lagged exchange rate are the major significant variables that influence real effective exchange rate. They recommend the Nigerian monetary authority to institute policies that minimize the magnitude of exchange rate volatility and the federal government to exercise control of macro-economic variables that have direct influence on exchange rate variation.

[Algieri \(2013\)](#) investigates the forces that drive exchange rate dynamics of the Russian real effective exchange rate over the transition period. He used five macroeconomic components in a time series dimension. His estimated results show positive long-run co-integration between the real exchange rate, oil prices, productivity and

government financial position, and negative co-integration with international reserves. Fiscal policies, however, were found to be alleviating of the influence of oil prices, terms of trade, and productivity shocks on the real exchange rate.

Kia (2013) investigates the determinants of the real exchange rate in Canada using a theoretical monetary model tested on Canadian data for the period 1972–2010. He examines the relationships between the real exchange rate, on the one hand, and each of real GDP, domestic and foreign interest rates, real money supply, the deficit per GDP, outstanding debt per GDP, real government expenditures, commodity price, and externally financed debt per GDP, on the other. His results disclose that, domestic externally financed debt, real money supply, and domestic and foreign interest rate have statistically significant impact on the Canadian dollar real exchange rate. Over the short run, his results provide empirical evidence that the growth of the real exchange rate is negatively influenced by each of the growth of money supply, the change in interest rate, the US debt per GDP, and the commodity price. Concurrently, Algieri (2013) investigates the forces that drive exchange rate dynamics of the Russian real effective exchange rate over the transition period. He used five macroeconomic components in a time series dimension. His estimated results show positive long-run co-integration between the real exchange rate, oil prices, productivity and government financial position, and negative co-integration with international reserves. Fiscal policies, however, were found to be alleviating of the influence of oil prices, terms of trade, and productivity shocks on the real exchange rate.

In 2014, Mourad Madouni examines the Equilibrium real exchange rate of the Algerian dinar from 1971 to 2012. He uses a co-integration method in order to test the long-run association between the real effective exchange rate, on the one hand, and oil prices (as a proxy variable for the terms of trade), government expenditure, relative productivity, and the openness. He found that the ERER movement is explained by openness, oil prices, relative productivity and the government consumptions. More specifically, he found positive correlation exists between ERER and each of terms of trade, government consumptions and openness. However, ERER shows adverse association with relative productivity. Dincer, Dincer, and Ustaoglu (2015) test three versions of the monetary model (the real interest differential, the flexible price, and the forward-looking models). Applying Johansen co-integration technique they conclude that monetary models do not provide the expected results. Their empirical findings revealed several shortcomings of the models. They, then, claim that invalidity of Keynesian money demand function is responsible for the unfavorable results.

Eslamloueyan and Kia (2015) develop and estimate a model of the real exchange rate for oil-producing countries in the Middle East and North Africa (MENA) for the period 1985–2009. They find that over the long-run, oil price, GDP, money supply, the U.S. externally financed debt per GDP, and government expenditure influence the real exchange rate. Over the short run, the study found that money supply; the changes in domestic real GDP; government expenditure; the U.S. debt per GDP domestic as well as U.S. interest rates, are the main determinants of the real exchange rates in these countries.

Altamony et al. (2016) investigate the long-run fundamental determinants of the real effective exchange rate (REER) of the Bahraini dinar. They use annual time series data mostly collected from economic indicators of Trading Economics 2016 and UNCTAD stat 2016. They analyze the impact of a range of macroeconomic variables including balance of payments as a proxy for supply and demand of Bahraini dinar, foreign direct investment outflows, inflation, interest rates, trade balance, trade openness, trade structure, money supply, gross domestic product, and trade similarity on the real effective exchange rate. The empirical findings reveal that the main long-run determinants of the foreign exchange rate are supply and demand, foreign direct investment outflows, inflation, interest rate changes, trade openness, trade structure, money supply, GDP, and trade similarity. Trade balance, however, was found to be insignificant determinant of the exchange rates. The real effective exchange rate was found to be positively correlated with each of balance of payments, trade structure, money supply, gross domestic product, and trade similarity. However, it was found to be negatively correlated with each of foreign direct

investment outflows, inflation, changes in interest rates, and trade openness. In addition, the impact of these explanatory variables comports, to a major extent, with the economic theory. Though the determination of exchange rate may depend on several other explanatory variables, the findings of this study may provide insight to monetary authorities on how to control exchange rate movements more effectively.

Kiptui, Moses, and Ndirangu (2016) examine the real exchange rate misalignment in Kenya using quarterly data over the period 2000 – 2014. They adopted the Behavioral Equilibrium Exchange Rate (BEER) approaches to determine the extent of exchange rate misalignment. By using a vector error correction model (VECM), the results show that the real exchange rate is largely driven by fundamentals. Thus, the equilibrium real exchange rate has been closely aligned to its long run equilibrium level, save for instances when misalignment occurred due to major economic shock such as the recent global financial crisis and the Euro zone economic crisis. According to the authors, the managed float regime in Kenya, exchange rates keep adjusting to changing economic fundamentals.

Houngbedji (2017) uses non-stationary panel econometrics techniques to identify the sources of real exchange rate misalignment in WAEMU countries over the period 1982-2016. The results of his study highlight the appreciation of Euro, which in the long run leads to an under-valuation of the real exchange rate, while the net external position of the economies contributes to its over-valuation. Moreover, he finds that the over-valuation of the real exchange rate is explained in the short term by the structural changes in the fundamentals of the economy and by the anchored exchange rate adopted by the Central Bank.

Engel and Zhu (2017) revisit a number of major exchange rate puzzles and conduct empirical tests to compare the behavior of real exchange rates among pairs of economies that have rigidly fixed nominal exchange rates with their behavior among pairs of economies under floating rates. They find that some of these puzzles become less puzzling for countries within the euro area, and regions in China and Canada, than for the non-euro-area OECD economies. They suggest that, under a rigidly fixed nominal exchange rate regime, the excess volatility puzzle of real exchange rates practically disappears or becomes minor for the vast majority of the fixed-rate economies; for them, there is less evidence for an excess reaction of the real exchange rate to the real interest rate differential; there is also less disconnect between the real exchange rate and the economic fundamentals; and uncovered interest rate parity appears to hold more frequently in these economies.

From these empirical and theoretical studies, it emerges that several methodological approaches make it possible to estimate real exchange rate fundamentals. This is the BEER approach, which in turn captures real exchange rate movements; the UIEB approach, which takes into account both the internal and external equilibrium of the real exchange rate; the CHEER approach captures the speed of convergence of the exchange rate in case of imbalance and finally the FEER approach, which in turn identifies the macroeconomic variables that influence the value of the exchange rate.

From the technical point of estimation, it is worth highlighting the use of time series and panel data. Identifying the long-term relationship between the real exchange rate and its fundamentals, leads to the use of an error-correction model. Thus, when it comes to panel data, the error-correction model results in one of the techniques of Pooled Mean Group developed by Pesaran et al. (1999). Pooled Mean Group's estimation makes it possible to have both the long run relationship and the short run relationship; it makes it possible to correct the problems of endogeneity of the model and to take into account the heterogeneity country. Despite all the empirical work done, the fact remains that this subject remains relevant because of the profound changes in the world economy. The financial crisis of 2008, the strong appreciation of the euro and the post-election crisis in Côte d'Ivoire are important factors that will have an impact on the CFER of the CFA franc and its fundamentals in WAEMU.

5. DATA, MODELS AND VARIABLES

The FEER approach is well recognized for the calculation of equilibrium real exchange rates. We follow Edwards (1989) in the definition of the REER, which results from the simultaneous realization of the internal and external equilibrium of the economy. A small open economy with three types of goods: as exportable goods, as importable goods and non-tradable goods. The economy produces exportables and non-tradables and consumes non-tradables and importables.

The economy is in flexible exchange rates and the nominal exchange rate is denoted E . This hypothesis may seem at first sight astonishing, especially since the countries in our sample are in fixed exchange rate. However, we are thinking here in a long-term perspective and also consider in the econometric part a long-term relationship. Of course, the exchange rate can be fixed in the short and medium term, but in the long run to maintain parity countries must have a sufficient amount of foreign exchange, which is not the case for the majority of countries in the world including those in our sample. Since the nominal exchange rate will eventually adjust, we assume here that it is flexible.

Let P_X and P_N be the domestic price of exportable goods and non-tradable goods respectively. The world price of exportable goods is standardized to one ($P_X^* = 1$) and the domestic price of exportable goods is defined by:

$$P_X = EP_X^* = E \quad (6)$$

$$\varepsilon_M = \frac{P_M}{P_N} \quad (7)$$

$$\varepsilon_X = \frac{E}{P_N} \quad (8)$$

The relative price of importables versus non-tradables will be

$$\varepsilon_M^* = \frac{EP_M^*}{P_N} \quad (9)$$

We assume that the economy adopts a tariff restriction on imports such as:

$$P_M = EP_M^* + \theta \quad (10)$$

Where θ is the customs tariff on imports (specific tariff). The total output of the two goods in the economy will be defined by:

$$Q = Q_X(\varepsilon_X) + Q_N(\varepsilon_X) \quad (11)$$

with $Q'_X > 0$ et $Q'_N < 0$, Q'_X et Q'_N being first-order derivatives with respect to elasticities.

Private overall consumption is given by:

$$C = C_M(\varepsilon_M) + C_N(\varepsilon_M) \quad (12)$$

With C_M and C_N domestic consumption of imported goods and non-tradable goods respectively. $C'_M < 0$, $C'_M > 0$; C'_M and C'_M being first-order derivatives with respect to elasticities.

We then define the real exchange rate as the relative price of tradables versus non-tradables:

$$\varepsilon = \alpha \varepsilon_M + (1-\alpha) \varepsilon_X = \frac{E(\alpha P_M^* + (1-\alpha)) + \alpha \theta}{P_N} \quad (13)$$

with $\alpha \in (0, 1)$.

We assume that capital is perfectly mobile in the long term and note by A , foreign assets. The agents hold part of their wealth in the form of foreign assets whose return is r^* . The country's current account is the sum of the net return of foreign assets held and the balance of the trade balance expressed in foreign currency, defined as the difference between exports and consumption of the importables, namely:

$$CA = r^*A + Q_X(\varepsilon_X) - P_M^*C_M(\varepsilon_M) \quad (14)$$

The change in foreign exchange reserves in the economy is given by: $\dot{R} = \dot{CA} + KI$ (15)

with KI the net capital flows.

In the short and medium term, the economy may deviate from the equilibrium, defined by ($R = 0$); and the stock of assets in the economy may vary. The current account is said to be sustainable when the current account deficit, the sum of the current account balance and capital flows, is zero:

$$r^*A + Q_X(\varepsilon_X) - P_M^*C_M(\varepsilon_M) + K = 0 \quad (16)$$

On the other hand, the internal balance is achieved when the internal market for non-tradable goods is in equilibrium, we have:

$$C_M(\varepsilon_M) + G_N = Q_N(\varepsilon_X) \quad (17)$$

with G_N public expenditure on non-tradable goods.

The equilibrium exchange rate is defined as the relative price that ensures both internal and external equilibrium. From relations (8) and (9), we can define the REER, ε^* depending on P_M^* , θr^* , A, KI and G_N

$$\text{So: } \varepsilon^* = \varepsilon^*(P_M^*, r^*, A, KI, G_N) \quad (18)$$

The equilibrium level of the real exchange rate is thus a function of the terms of trade, trade policy, foreign interest rate, foreign capital flows, and government expenditures. The variables in Equation 17 are the fundamentals of the long-run equilibrium real exchange rate. An increase in public spending on non-tradable goods leads to an appreciation of the real exchange rate, which is a deterioration of the country's competitive position. Trade liberalization leads to a real depreciation of the domestic currency, which is necessary to improve the country's competitive position. An improvement in the current account is associated, in the long run, with an appreciation of the real exchange rate. The terms of trade effect are uncertain. On the one hand, the increase in the terms of trade results in an increase in national income and therefore in spending, which leads to a real appreciation. On the other hand, this increase will generate a substitution effect that leads to real depreciation. Elbadawi and Soto (1995) have studied 7 developing countries and have found that for three of them, the term-of-trade improvement leads to an appreciation of the real exchange rate, while for the other four, it leads to an increase in the real exchange rate. Feyzioglu (1997) finds for Finland that an improvement in the terms of trade is reflected in an appreciation of the real exchange rate.

Starting from the theoretical framework, the long-term relationship to be tested between the real exchange rate and its fundamentals is written:

$$TCRE_{it} = \alpha_i + FUND_{it}\beta + \vartheta_{it} \quad (19)$$

where RERE is the effective real exchange rate, FUND is the vector of the different fundamentals, α_i is a vector of the constant terms of the model, β is a vector of parameters to be estimated and ϑ_{it} is a vector of perturbations of the model; with $i = 1, 2, \dots, N$ and $t = 1, 2, \dots, T$.

In an explicit way, the econometric form is written:

$$LRERE_{it} = \alpha_{it} + \beta_{1t}LTDE_{it} + \beta_{2t}LOUV_{it} + \beta_{3t}LINV_{it} + \beta_{4t}LBC_{it} + \beta_{5t}LPROD_{it} + \beta_{6t}LGOUV_{it} + \beta_{7t}DEVAL_{it} + \beta_{8t}CRISEPOL_{it} \quad (20)$$

- LRERE: the logarithm of the effective real exchange rate side to the uncertain.
- LTDE: the logarithm of the terms of trade (net barter).
- LOUV: the logarithm of trade openness, defined as the ratio of the sum of exports and imports to GDP.
- LBC: the logarithm of the trade balance compared to GDP.
- LINV: the log of investment as a percentage of GDP.
- LGOUV: the logarithm of the share of public expenditure in GDP.
- LPROD: the logarithm of relative GDP per capita, PPP.
- DEVAL: it is a dummy variable which takes the value 0 before 1994 and 1 after the devaluation.

- CRISEPOL: it is also a dummy variable to capture the effects of the socio-political crisis in Côte d'Ivoire. Thus, this variable takes the value 0 before 1999 and 1 after 1999.

5.1. Variables and Expected Signs

Starting from the econometric model, it is necessary to show how the fundamentals affect the behavior of the real effective exchange rate. Terms of the exchange of goods (TDE): the TDEs affect the equilibrium real exchange rate through the wealth effect. A positive shock on the TDEs leads to an increase in domestic demand, thus an increase in the relative price of non-tradable goods, which leads to the appreciation of the ERT. Alternatively, starting from the point of view of internal-external equilibrium, an increase in the TDE leads to an increase in real wages in the export sector and the trade surplus. In order to restore the external equilibrium, the REER must be appraised. To do this, the expected sign is positive (+). However, it is noted that if the substitution effect is achieved by increasing the national income that will supply domestic demand with domestic production, the exchange rate depreciates in this case. In sum, the expected sign is relatively ambiguous. Share of public expenditure in GDP (GOUV): given the difficulty in distinguishing between government consumption, that is attributable to tradable goods and non-tradable goods, we will use public consumption as a proxy for non-tradable goods the share in the Gross Domestic Product of government expenditure; This is easily understood to the extent that government expenditure is made up of a high proportion of non-tradable goods while investments contain a large share of imported goods. GOUV will therefore be noted as the share of government expenditure in the gross domestic product. This government behavior variable has a significant impact on the equilibrium exchange rate. Its sign is ambiguous because the impact of government expenditure depends on the relative importance of changeable goods and non-tradable goods in the economy. Thus, if government expenditure increases in the non-tradable sector, this will have a positive effect on the real exchange rate by increasing the price of non-tradables and the GOUV variable will have a positive sign. If, on the other hand, the proportion of government expenditure falls despite increased government expenditure, this will obviously lead to a depreciation of the real exchange rate. Degree of protection or trade restrictions (OUV): a reduction in trade barriers leads to an increase in trade, particularly imports. Thus, a demand for imports leads to an internal-external imbalance, which requires depreciation to correct the imbalance. For this, the expected sign for this variable is negative. To capture trade restrictions, we will use a proxy that is OPEN (tradeopenness). Productivity (PROD): it captures the Balassa - Samuelson effect. An increase in productivity, in the tradable goods sector at the expense of nontradables, in a country relative to the rest of the world increase relative wages. This rise in wages causes an increase in the relative prices of non-tradable goods relative to tradable goods and makes the ERRE appreciate. The expected sign is therefore positive. Investment (INV): Edwards (1989) suggests that taking into account the investment in the REER theory of determination results from the supply effects, which depend on the relative intensity of the different factors. Thus, the expected sign is a priori ambiguous. However, for a developing country whose investments make it possible to import goods, one can of course witness a depreciation of the RER and therefore the expected sign may be negative. DEVAL: the devaluation is a downward adjustment of the value of the currency, it is a dummy variable that takes the value 0 before 1994 and 1 after. The expected sign is negative. CRISEPOL: it is also a dummy variable to capture the effects of the social crisis.

5.2. Variables and Data

The data on the variables relate to 7 out of 8 WAEMU countries (except Bissau Guinea) and cover the period from 1984 to 2014 and these are secondary data mainly from the World Bank's database (World Bank, 2016) financial statistics International (International Monetary Fund) (IMF) and Penn World Table.

5.3. Econometric Estimation Techniques

5.3.1. Panel Unit Root test

As pointed out in the work of Okey (2009) the traditional Dickey-Fuller augmented unit root test (ADF) suffers from a problem of weak rejection of the null hypothesis of series stationarity, especially for short period. Thus, recent literature shows that stationarity tests on panels are more powerful than those based on individual time series (Al-Iriani, 2006). Among the recently developed tests we have, the unit root test LLC Levin, Lin, and Chu (2002); IPS by Im, Pesaran, and Shin (2003), Hadri (2000) and Breitung, Shu, and McMahon (2000). Narayan and Smyth (2009) used the Breitung et al. (2000) because this test is generally more robust than any first-generation panel unit root test. Apergis and Payne (2009) use the IPS test which is more general and popular and based on the principle of ADF testing. Note that the unitary panel test of Breitung et al. (2000) and Levin et al. (2002) assumes a homogeneous autoregressive unit root (under the alternative hypothesis, the autoregressive coefficient is the same for all individuals for the LLC test), whereas Im et al. (2003) assume a heterogeneous unit root (the alternative hypothesis), allows the presence of a subset of individuals of size N_1 whose variable of interest follows a stationary process. The unit root tests of Im et al. (2003) therefore take heterogeneity into account (Hurlin & Mignon, 2005).

$$Y_{it} = \rho_i Y_{it-1} + \sum_{j=1}^{p_i} \mu_{ij} \quad (21)$$

$H_0: \rho_i = 1, \forall i$ ((all series of the panel contain a unit root)).

$H_0: \rho_i < 1$ (at least one of the individual series of the panel is stationary).

The T-bar statistics specified by Im et al. (2003) is the average of the individual ADF statistics. $T\text{-bar}_{NT} = \frac{\sum_{j=1}^N [t_{\rho_i}]}{N}$ (22)

t_{ρ_i} , ADF statistics of the individual series of the panel, the Monte-Carlo simulations show that T-bar is normally distributed.

5.4. Panel Cointegration Test

The concept of cointegration can be defined as a systematic long-term co-movement between two or more economic variables (Yoo, 2006). Pedroni (2000); Pedroni (2004) proposes an extension to the case where the cointegration relationships comprise more than two variables and develops for this purpose seven (7) tests based on the estimation of the residual of the long-term model. Pedroni's tests take into account heterogeneity through parameters that may differ between individuals. Thus, under the alternative hypothesis, there is a cointegration relation for each individual, and the parameters of this cointegration relationship are not necessarily the same for each of the individuals on the panel (Hurlin & Mignon, 2005). In addition, Kao (1999) also proposed tests of the null hypothesis of no cointegration: Dickey-Fuller type test and Augmented Dickey-Fuller type test.

In contrast to Pedroni's tests, Kao considers the particular case where cointegration vectors are assumed to be homogeneous between individuals. In other words, these tests do not make it possible to take heterogeneity into account under the alternative hypothesis and are otherwise valid only for a bivariate system (i.e. where only one regressor is present in the cointegration relation). Finally, McCoskey and Kao (1999) proposed a test of the null hypothesis of cointegration in heterogeneous panels. This is a residual test of the Lagrange multiplier that can be compared to the Shin test developed in the case of time series.

Indeed, as part of our work, we will use the methodology proposed by Kao (1999) because of the size of our sample, the Kao test will allow us to have robust results because this methodology is more adapted to samples of small size.

5.5. Long Run Relationship Estimation: Pooled Mean Group (PMG)

The PMG estimate proposed by Pesaran et al. (1999) constrains the long-term coefficients to be identical to that of the error-correction model, but the long-term coefficients may differ from the variances of the errors. This estimator is constructed under the assumption of heterogeneity of short-term coefficients and homogeneity of long-term slope coefficients (Pesaran et al., 1999). Initial conditions are treated as fixed or random and long-term coefficients are a non-linear combination of short-term coefficients. The Pooled-Mean Group's foundation is based on the ARDL (autoregressive distributed lag) model estimate of order (pi, qi).

$$\Delta y_{it} = \phi_i y_{it-1} + \beta_i x_{it} + \sum_{j=1}^{p_i-1} \Psi_{ij} \Delta y_{it-j} + \sum_{j=0}^{q_i-1} \delta_{ij} \Delta x_{it-j} + \alpha_i + \varepsilon_{it} \quad (23)$$

y_{it} is the dependent variable, x_{it} is the vector of independent variables, α_i is the coefficient that captures the country-specificities, Ψ_{ij} et δ_{ij} represent the coefficients short term dynamic and ε_{it} is the error term of the model.

The long-run coefficients are assumed to be the same for all countries. Thus, if ϕ_i is significantly negative, then we can conclude that there is a long-term relationship between the independent variable and the explanatory variables.

As such, the use of traditional estimation techniques (Ordinary Square Least, fixed effects, and random effects) leads to non-convergent estimators. To overcome this endogeneity problem, the authors use the generalized moment method (GMM). But this method has some disadvantages, in particular, the homogeneity of the coefficients, except for the constant which captures the specific effects. This homogeneity implies that the effect of a variable cannot differ from one country to another. Indeed, the GMM approach ignores the unit root and cointegration properties of the series, it is difficult to clearly state that the results provide long-term effects or fallacious results. In addition, in a dynamic panel, the homogeneity of the coefficient of the delayed endogenous variable can lead to biases. The delayed variable is, therefore, an explanatory variable.

In addition, the number of countries is less important than the period in our dynamic panel. Hence the use of GMM estimators is not appropriate. For all these reasons, we use the Pool Mean Group method for the different estimates in this research. The Pooled Mean Group (PMG) estimator has an advantage in the treatment of dynamic panels for which the number of temporal observations T is more important than that of individuals N (Pesaran et al., 1999). It offers the possibility of estimating a long-term relationship between different variables, without prior precautions about stationarity or even the existence of a cointegrating relationship between them. The PMG approach is essentially a version of the ARDL panel procedure and consists of the maximum likelihood estimation of the ARDL model, which can be rewritten as an error correction model (ECM). The estimation of this model simultaneously evokes the intra and inter dimensions. Pesaran et al. (1999) did not propose a formal cointegration test but derived asymptotic properties for both stationary and non-stationary regressors. Pedroni also notes that when the cointegration vector is homogeneous, the performance of the estimation by MG-FMOLS is better than that of the Intra estimator for small samples. Because PMG estimation imposes long-term homogeneity, it can also produce inconsistent estimators if the homogeneity assumption is violated. However, if the long-term cointegration vector is homogeneous across different individuals, the PMG estimate is relatively efficient compared to GM-FMOLS. This approach is considered in this study.

6. RESULTS AND DISCUSSIONS

According to Table 1, overall, all the variables are stationary after a differentiation except the variable LPROD which is stationary at level. Concretely, apart from LPROD which is integrated in the order 0, I (0), all the others are integrated in order 1 so, I (1). We can then suspect a cointegration relationship between the different variables.

Table-1. Panel unit root tests.

Variables	Panel Unit Root Tests		
	LLC	Breitung	IPS
DLRERE	-4.01 (0.00)	-4.58 (0.00)	-4.93 (0.00)
DLTDE	-2.74 (0.00)	-3.53 (0.00)	-5.30 (0.00)
LPROD	-4.64 (0.00)	-7.62 (0.00)	-3.47 (0.00)
DLOUV	-6.78 (0.00)	-4.49 (0.00)	-6.61 (0.00)
DLINV	-11.04 (0.00)	-5.37 (0.00)	-121.70 (0.00)
DLGOUV	-3.06 (0.00)	-6.54 (0.00)	-6.53 (0.00)
DLBC	-6.17 (0.00)	-3.83 (0.00)	-7.11 (0.00)

6.1. Panel Cointegration Test

Given the size of our sample, among the various cointegration tests for panel data, [Kao \(1999\)](#) is used to test the cointegration relationship of the real effective exchange rate and its fundamentals. Recall that the Kao test is based on the null hypothesis of no cointegration. Thus, the results show that the probability associated with T-statistics is 0.00; this makes it possible to reject the null hypothesis of the absence of cointegration. We can therefore say that there is a cointegrating relationship between the real effective exchange rate and its fundamentals, including productivity, trade openness, investment, terms of trade, and trade balance.

To estimate the relationship between the effective real exchange rate and its fundamentals, we used a panel error correction model technique, using the Pooled Mean Group method developed by [Pesaran et al. \(1999\)](#) under Stata 13. The estimation results are in two phases, namely the long-term determinants and the short-term determinants of the real exchange rate of the CFA franc in the WAEMU zone. In addition, the estimate of the long-term relationship will finally make it possible to calculate the misalignments of the effective real exchange rate of the CFA franc.

6.2. Long run Relationship between the Real Exchange Rate of the CFA franc and its Fundamentals in WAEMU

[Table 2](#) presents the results of the estimation of the ARDL model by pooled mean group technique. According to the results, the investment positively and significantly explains the real exchange rate of the CFA in WAEMU. In fact, an increase in investment of 1% leads to the appreciation of the exchange rate of 0.97%. This result is consistent with the theory and we can say that investments in WAEMU allow the acquisition of capital goods which in turn will contribute to increase the production capacity for export in the long term.

Table-2. Results of the estimation of the ARDL model by the pooled mean group technique.

Variables	Coefficients	Probability
Linv	0.97	0.00
Lgouv	-0.77	0.03
Ltde	0.28	0.21
Lbc	0.21	0.00
Louv	0.78	0.00

Government spending, on the other hand, significantly depreciates the real exchange rate of the CFA franc. For example, a 1% increase in government expenditure reduces the value of the exchange rate by 0.77%. The sign of the government expenditure ratio is of course justified by the fact that these expenditures are often intended for the purchase of imported goods and services. This import operation consists of a CFA offer, which reduces the value of the currency. Theoretically, this result is observed in developing countries, unlike in developed countries, where the expected sign is positive because government expenditure is supposed to allow the acquisition of capital goods to satisfy domestic demand and the export of the surplus generated by the domestic production. [Eslamloueyan and Kia \(2015\)](#) estimated a model of the real exchange rate for oil-producing countries in the Middle East and North Africa (MENA) for the period 1985–2009 and found that government expenditure influences the real exchange rate.

In contrast to government spending, the terms of trade, taken in this net barter research, have a positive and insignificant effect on the real exchange rate of the CFA franc in the area. Indeed, an increase in terms of trade of 1%, raises the exchange rate by 1.09%. This result is theoretically obvious because an increase in the prices of exported goods, all things being equal, increases the demand for the local currency that is the CFA, and therefore an increase in the value of the exchange rate.

As in the case of the negative effect of government spending, the trade balance in WAEMU countries puts upward pressure on the value of the exchange rate. Thus, a 1% increase in the value of the trade balance increases the value of the exchange rate by 0.21%. This is explained by the fact that the trade balances of the WAEMU countries, with the exception of Côte d'Ivoire, are structurally deficit. In practice, these countries export less than they import goods and services. However, if the effect is positive, it would simply mean that imports of capital goods could strengthen the industrial fabric and increase exports, which will make the real exchange rate appreciate in the long run.

Trade openness exerts a positive and significant pressure on the real exchange rate of the CFA franc. A 1% increase in the degree of trade openness makes the real exchange rate appreciate by 0.77%. This effect is contrary to the prescriptions of economic theory. Indeed, trade openness should allow a reduction in trade barriers and favor imports, which in turn will lead to a depreciation of the exchange rate. However, the positive effect may be justified by the fact that trade openness could lead to the importation of capital goods, which in the long run will promote exports and exert upward pressure on actual real exchange rate of the CFA franc. The dummies whose devaluation and the political crisis experienced by Côte d'Ivoire both have a positive effect on the real exchange rate of the CFA franc in the zone. Both the panel error correction model and the time series model highlight not only the long-term relationship but also the short-term relationship. Compared to our findings, [Altamony et al. \(2016\)](#) investigate the long-run fundamental determinants of the real effective exchange rate (REER) of the Bahraini dinar. Their empirical findings reveal that, in long-run, relationship the determinants of the foreign exchange rate are supply and demand, foreign direct investment outflows, inflation, interest rate changes, trade openness, trade structure, money supply, GDP, and trade similarity.

In contrast to the long-run relationship, the short-run relationship estimate shows the following effects of the different variables of the estimated model.

Table-3. Short run coefficients.

Variables	Coefficients	Probability
Lprod	0.26	0.01
Linv	-0.02	0.52
Lbc	-0.21	0.03
Lgouv	0.03	0.67
Ltde	0.58	0.25
Louv	0.04	0.54

The results of the estimation presented in [Table 3](#) show that only productivity has a significant effect on the real exchange rate of the CFA franc in WAEMU. Indeed, productivity positively affects the exchange rate, which is in line with economic theory. Thus, a productivity improvement of 1% results in an appreciation of the real exchange rate of 0.26%. In concrete terms, this result would mean that an improvement in productivity in the WAEMU countries compared to their trading partners leads to a reduction in the price of tradable goods. Thus, because of this fall in prices, these goods will have a comparative advantage compared to the rest of the world and therefore we will witness an increase in exports and ultimately a real exchange rate appreciation. This result is in line with the work of [Couharde, Coulibaly, and Damette \(2011\)](#) whose results also show a positive effect of 0.30%. [Madouni \(2014\)](#) examines the Equilibrium real exchange rate of the Algerian dinar from 1971 to 2012 and find that

the ERER movement is explained by openness, oil prices, relative productivity and the government consumptions. However, ERER shows adverse association with relative productivity. This result doesn't confirm our finds.

The trade balance, unlike its long-term positive effect in the short run, has a negative and significant effect on the real effective exchange rate. Given the chronic trade deficits observed in the WAEMU countries, in the short term, the effect of imports on the exchange rate wins and therefore the trade balance depreciates the real exchange rate. Thus, a 1% increase in the trade balance depreciates the real effective exchange rate by 0.21%. However, Altamony et al. (2016) investigating the long-run fundamental determinants of the real effective exchange rate (REER) of the Bahraini dinar find that trade balance, insignificant determine the exchange rates. The real effective exchange rate was found to be positively correlated with each of balance of payments, trade structure, money supply, gross domestic product, and trade similarity.

According to the results of our estimates, the main fundamentals of the real long-term effective exchange rate of the CFA franc in WAEMU are investment, trade balance, government expenditures and trade openness. From these results, it follows that government expenditures mainly finance imports. It is then necessary to find a solution to this extroversion of our economies, which solution would be the promotion of the import substitution policy. It is a matter of concretely reinforcing the industrial fabric of the economies of the union to try to secure a large part of the domestic demand. This increase in domestic supply will reduce the size of the chronic deficit of the trade balance of the WAEMU countries. A policy should be put in place to enable our economies to benefit from trade liberalization. This involves promoting exports of high value-added products in order to improve the external position of economies and to address the instability of commodity prices on which developing country exporters of primary goods depend. As an instrument, it requires an incentive tax policy of the governments of the WAEMU countries to allow investors to set up and produce. This will improve national productive capacity and lead to export diversification.

7. FINALS REMARKS

The literature review on the empirical evaluation of the relationship between the real exchange rate and its fundamentals is prolix. Indeed, despite the different methodological approaches used to estimate this relationship, the general trend is that there is a significant relationship between the real exchange rate and its fundamentals. The objectives of this work being to identify the fundamentals that explain the behavior of the real exchange rate of the CFA franc in WAEMU and to estimate the degrees of misalignment, two hypotheses have been put to this effect. The first asserts that the fundamentals actually explain the behavior of the real exchange rate of the CFA franc and the second assumes that the CFA franc is currently overvalued. At the end of our research, estimates show that the real exchange rate of the CFA franc is influenced in equilibrium by investment, trade balance, trade opening and long-term government spending; in the short term, only productivity and the trade balance affect the real exchange rate of the CFA franc in WAEMU. This first result confirms one of our basic assumptions that the real exchange rate of the CFA franc in WAEMU is explained by its fundamentals.

Funding: This study received no specific financial support.

Competing Interests: The authors declare that they have no competing interests.

Acknowledgement: Both authors contributed equally to the conception and design of the study.

REFERENCES

- Ajao, M. G., & Igbekoyi, O. E. (2013). The determinants of real exchange rate volatility in Nigeria. *Academic Journal of Interdisciplinary Studies*, 4(1), 459-447.
- Al-Iriani, M. A. (2006). Energy-GDP relationship revisited: An example from GCC countries using panel causality. *Energy Policy*, 34(17), 3342-3350. Available at: <https://doi.org/10.1016/j.enpol.2005.07.005>.

- Algieri, B. (2013). Determinants of the real effective exchange rate in the Russian Federation. *The Journal of International Trade & Economic Development*, 22(7), 1013-1037. Available at: <https://doi.org/10.1080/09638199.2011.631216>.
- Altamony, H., Al-Salti, Z., Gharaibeh, A., & Elyas, T. (2016). The relationship between change management strategy and successful enterprise resource planning (ERP) implementations: A theoretical perspective. *International Journal of Business Management and Economic Research*, 7(4), 690-703.
- Apergis, N., & Payne, J. E. (2009). Energy consumption and economic growth in Central America: Evidence from a panel cointegration and error correction model. *Energy Economics*, 31(2), 211-216. Available at: <https://doi.org/10.1016/j.eneco.2008.09.002>.
- Breitung, E. M., Shu, C.-F., & McMahon, R. J. (2000). Thiazole and thiophene analogues of donor– acceptor stilbenes: Molecular hyperpolarizabilities and structure– property relationships. *Journal of the American Chemical Society*, 122(6), 1154-1160. Available at: <https://doi.org/10.1021/ja9930364>.
- Clark, P. B., & MacDonald, R. (1999). Exchange rates and economic fundamentals: A methodological comparison of BEERS and FEERS. In *Equilibrium Real Exchange Rates*, Ed. by R. MacDonald and J.L. Stein (pp. 209-240). Massachusetts: Kluwer Academic Publishers.
- Coudert, V., Couharde, C., & Mignon, V. (2011). Does euro or dollar pegging impact the real exchange rate? The case of oil and commodity currencies. *The World Economy*, 34(9), 1557-1592. Available at: <https://doi.org/10.1111/j.1467-9701.2011.01400.x>.
- Couharde, Coulibaly, & Damette, O. (2011). *Equilibrium exchange rate and adjustment process for the CFA franc*. Paper presented at the Conference on Growth Dynamics Within the WAEMU.
- D'Almeida, C. (1998). *The future of the CFA franc* (2nd ed., pp. 328). Paris: African Perspectives.
- Dincer, M. Z., Dincer, F. I., & Ustaoglu, M. (2015). Real effective exchange rate volatilities impact on tourism sector in Turkey: An empirical analysis of 2003-2014. *Procedia Economics and Finance*, 23, 1000-1008. Available at: [https://doi.org/10.1016/s2212-5671\(15\)00352-4](https://doi.org/10.1016/s2212-5671(15)00352-4).
- Djoulfelkit-Cottenet, H. (2006). Evolution of the TCER of the franc zone: 1993-2006. AFD, Thematic Report, (15).
- Djoulfelkit-Cottenet, H. (2007). What debt policy for African countries after a decade of debt forgiveness ?
- Driver, R. L., & Westaway, P. F. (2004). Concepts of equilibrium exchange rates. Working Paper No. 248.
- Edwards, S. (1989). *Real exchange rates, devaluation, and adjustment: Exchange rate policy in developing countries*. Cambridge, Massachusetts: MIT Press.
- Elbadawi, I. A. (1999). *Can Africa export manufactures? The role of endowment, exchange rates, and transaction costs*: The World Bank.
- Elbadawi, I. A., & Soto, R. (1995). *Real exchange rates and macroeconomic adjustment in Sub-Saharan Africa and other developing countries'*. Paper presented at the In Bi-Annual Research Workshop of the African Economic Research Consortium, Johannesburg.
- Engel, C., & Zhu, F. (2017). *The price, real and financial effects of exchange rates*. Paper presented at the BIS-HKMA Conference 28-29 August 2017, Hong Kong Monetary and Economic Department.
- Eslamloueyan, K., & Kia, A. (2015). Determinants of the real exchange rate in oil-producing countries of the middle east and North Africa: A panel data investigation. *Emerging Markets Finance and Trade*, 51(4), 842-855. Available at: <https://doi.org/10.1080/1540496x.2015.1043213>.
- Feyzioglu, M. T. (1997). *Estimating the equilibrium real exchange rate: An application to Finland (No. 97-109)*: International Monetary Fund.
- Ha, T. T. D., & Pham, T. T. T. (2012). Fundamental determinants of Vietnam's equilibrium real effective exchange rate and its misalignment. DEPOCEN, Working Paper Series No. 2012/ 20.
- Hadri, K. (2000). Testing for stationarity in heterogeneous panel data. *The Econometrics Journal*, 3(2), 148-161. Available at: <https://doi.org/10.1111/1368-423x.00043>.
- Hinkle, & Montiel. (1999). *Exchange rate misalignment: Concepts and Measurement for Developing Countries*. Washington: World Bank.

- Ho, C. S., & Ariff, M. (2011). Measuring the Time-to-Equilibrium in Exchange Rates: Application to G-10 & Eastern Europe.
- Houngbedji, H. S. (2017). Sources of misalignment of real exchange rates in WAEMU. *Theoretical and Applied Economics Journal*, 7(2), 187-206.
- Hurlin, C., & Mignon, V. (2005). A synthesis of unit root tests on panel data. *Economy Forecast*, 3, 253-294.
- Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1), 53-74. Available at: [https://doi.org/10.1016/s0304-4076\(03\)00092-7](https://doi.org/10.1016/s0304-4076(03)00092-7).
- Johansen, S., & Juselius, K. (1992). Testing structural hypothesis in a multivariate cointegration analysis of the PPP and the UIP for UKp. *Journal of Econometrics*, 53(1-3), 211&244. Available at: [https://doi.org/10.1016/0304-4076\(92\)90086-7](https://doi.org/10.1016/0304-4076(92)90086-7).
- Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*, 90(1), 1-44. Available at: [https://doi.org/10.1016/s0304-4076\(98\)00023-2](https://doi.org/10.1016/s0304-4076(98)00023-2).
- Kia, A. (2013). Determinants of the real exchange rate in a small open economy: Evidence from Canada. *Journal of International Financial Markets, Institutions and Money*, 23, 163-178. Available at: <https://doi.org/10.1016/j.intfin.2012.09.001>.
- Kiema, Nubukpo, & Sanou. (2011). *Impact of a devaluation of the CFA franc on the trade balance and production in the WAEMU countries*. Paper presented at the Conference on Dynamics of Growth Within the WAEMU.
- Kiptui, Moses, C., & Ndirangu, L. (2016). Determinants of equilibrium real exchange rate and its misalignment in Kenya: A behavioral equilibrium exchange rate approach. Kenya School of Monetary Studies, MPRA Paper No. 70542.
- Levin, A., Lin, C.-F., & Chu, C.-S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108(1), 1-24. Available at: [https://doi.org/10.1016/s0304-4076\(01\)00098-7](https://doi.org/10.1016/s0304-4076(01)00098-7).
- MacDonald, R. (2000). Concepts to calculate equilibrium exchange rates: An overview.
- Madouni, M. (2014). Real exchange rate misalignment in Algeria. *International Journal of Arts and Commerce*, 3(5), 37-50. Available at: <https://doi.org/10.11648/j.ijefm.20140205.12>.
- McCoskey, S., & Kao, C. (1999). A Monte Carlo comparison of tests for cointegration in panel data. *Available at SSRN 1807953*.
- Narayan, P. K., & Smyth, R. (2009). Multivariate Granger causality between electricity consumption, exports and GDP: Evidence from a panel of Middle Eastern countries. *Energy Policy*, 37(1), 229-236. Available at: <https://doi.org/10.1016/j.enpol.2008.08.020>.
- Okey. (2009). Energy consumption and GDP growth in the WAEMU: Panel data analysis. Munich Personal RePEc Archive Paper, No 15521.
- Pedroni, P. (2000). Fully modified OLS for heterogeneous cointegrated panels. *Advances in Econometrics*, 15, 93-130. Available at: [https://doi.org/10.1016/s0731-9053\(00\)15004-2](https://doi.org/10.1016/s0731-9053(00)15004-2).
- Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric Theory*, 20(3), 597-625. Available at: <https://doi.org/10.1017/s0266466604203073>.
- Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*, 94(446), 621-634. Available at: <https://doi.org/10.1080/01621459.1999.10474156>.
- Rogoff, K. (1996). The purchasing power parity puzzle. *Journal of Economic Literature*, 34(2), 647-668.
- Saxegaard, M., Roudet, S., & Tsangarides, M. C. G. (2007). *Estimation of equilibrium exchange rates in the WAEMU: A robustness approach (No. 7-194)*: International Monetary Fund.
- Williamson. (1994). *Estimating equilibrium exchange rates*. Washington, DC: Institute of International Economics.
- World Bank. (2016). World development indicators (WDI).
- Wren-Lewis, S. I. M. O. N. (1992). Why the pound should be devalued inside the ERM. *Economic Outlook*, 16(5), 35-38. Available at: <https://doi.org/10.1111/j.1468-0319.1992.tb00167.x>.
- Yoo, S.-H. (2006). The causal relationship between electricity consumption and economic growth in the ASEAN countries. *Energy Policy*, 34(18), 3573-3582. Available at: <https://doi.org/10.1016/j.enpol.2005.07.011>.

Views and opinions expressed in this article are the views and opinions of the author(s). The Economics and Finance Letters shall not be responsible or answerable for any loss, damage or liability etc. caused in relation to/arising out of the use of the content.