Analysis of the Determinants of the Demand for Money in the Franc Zone: A Study of Panel Data

Author Détails: Rémy Hounsou, Ph.D.
Ecole Nationale d'Economie Appliquée et de Management (ENEAM),
Université d'Abomey Calavi, BENIN.

Abstract: *This study uses panel data covering the period 1985-2015 to analyze the determinants and long-term behavior of the demand for money function in the Franc Zone. The empirical results based on OLS, FMOLS and DOLS methods suggest that monetary aggregates in the narrow sense (m_1-p) or in the broad sense (m_2-p) are related to the following internal explanatory variables: income, inflation and credit to the economy and the following external explanatory variables: the change in the real exchange rate of the CFA Franc relative to the US dollar and the difference between the interest rate on deposits in France and that of the countries in the Franc Zone. Moreover, the results indicate that these variables are for the most part non-stationary in level but that there exists between them a long-term cointegration relation which makes the two functions of demand for money stable. These results are robust and attest to the usefulness and effectiveness of the econometric analysis of non-stationary panel data in the institutional framework of the Franc Zone.*

Keywords: *money demand, Zone Franc, Panel data, Unit root tests, Cointegration tests*

Classification: JEL: E41, C33, O55

1. Introduction

The study of the money demand function is important in the formulation of monetary policies aimed at influencing economic variables. The stability of the demand for money has implications in the choice of the monetary policy instruments. According to Poole (1970), the goal of the monetary policy is to target the interest rate if the LM curve is unstable while the money supply is the target when the IS curve is unstable. Since the LM curve's instability results in great part in the instability of the demand for money function, it is important to know the determinants of the demand for money function and its stability effect. In the developing countries, three important factors have influenced the application of monetary policies and influenced the behavior of the money demand function. These include (i) the existence of a nascent financial sector dominated by governments, (ii) small open economies that are subject to external factors, and (iii) Monetary policies that are credible only by tying the local currency to the currencies of the weekly industrialized economies (Wong, 1977 and Huang and Wei, 2006).
The purpose of this study is to analyze the determinants and the long-term behavior of the money demand function in the Franc Zone. This approach consists of treating the Franc Zone as a unique institutional framework that deserves to be analyzed in its specificity as suggested by Sugimoto (2001). In this perspective, it is interesting to analyze the implication of the monetary policy of the Franc Zone from the stability of the demand for money.
The Franc Zone includes 14 countries in sub-Saharan Africa, including eight countries of the West African. Economic and Monetary Union (WAEMU) and six countries of the Central African Economic and Monetary Union (CAEMU). The WAEMU includes Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. Mali left the Franc Zone in 1962 and then reinstated it in 1984; Guinea-Bissau, formerly a Portuguese colony, was admitted to the union in 1997. The CAEMU includes Cameroon, the Central African Republic, Congo, Gabon, Equatorial Guinea and Chad; Equatorial Guinea, the former Spanish colony, was integrated into the Zone in 1985.

The objective of the central banks of the Franc Zone composed of the Central Bank of West African States (BCEAO) for WAEMU and the Bank of Central African States (BEAC) for CAEMU-was to lead a regional monetary policy that takes into account the fixed exchange rate constraints between the CFA Franc and the French Franc (The Euro since 2002) in an institutional framework that has undergone continuous change since the colonial period. It emerges from the practice of these central banks that the money supply has for a long time been more influenced by changes in the monetary base than by the credit multiplier. The counterparts of this money supply are the claims on the State, claims on the economy and external assets. From this perspective, it is clear that an important role is played by the central bank in the creation of money and the management of credit for the benefit of the second-tier banks. For a long time, the instruments of monetary policy were direct, relying for the BCEAO on global assistance and the sectoral orientation of financing and the BEAC on the policy of rediscount ceilings. Bourdin (1980), Tchundjand (1980), Koulibaly (1992), Nguessan (1996), and Parmentier and Tenconi (1996) have highlighted the poor performance of these direct intervention practices.

Since 1994 the trend has been to gradually dismantle the direct intervention policy towards indirect control instruments where the interest rate now takes into account the market conditions of the member countries of the Franc Zone and the changes in interest rates interests of economic partners such as France and the European Union. However, this liberalization of monetary policy through instruments of indirect control will create an uncertain environment in the application of monetary policy, which requires both central banks to collect more information at the level of the economy in general, but particularly in terms of the rate of interest, the volume of credit to the economy, and the demand for money by economic agents.

To analyze the determinants and stability of the demand for money in the Franc Zone, this study uses panel data covering the period 1985-2015. The period is long enough to judge and test the existence of a long-term relationship between the demand for money and some explanatory variables. Moreover, the period is rich in events that have marked the economic history of these countries and affected the direction of monetary policy. For example, the 1980s were marked by a period of boom followed by a crisis in commodity prices and rapid growth in the external indebtedness of the member countries of the Zone. Second, the 1990s saw an acute crisis in the liquidity of banks and a prolonged imbalance in the real effective exchange rate, which led to the devaluation of the CFA franc in 1994. Finally, the post-1994 period saw the emergence of stabilization and allowed a reform of the monetary space for an environment more favorable to an increased macroeconomic interdependence of the countries of the Franc Zone (Sedemo and Villieu 1997). Thus, the West African Monetary Union (WAMU) becomes the West African Economic and Monetary Union (WAEMU), while the Bank of Central African States (BEAC) headed the Central African Economic and Monetary Union (CAEMU)

The remainder of the article is as follows: Section 2 discusses the experience of monetary policy in the countries of the Franc Zone. Section 3 examines the structure of the model whose analysis of the results is presented in Section 4. Section 5 concludes the study.

2. Monetary policy experience

Monetary policy in the Franc Zone countries is linked to the Monetary and Financial Cooperation Agreements between France and these countries. These agreements are essentially based on (i) a fixed exchange rate between the French Franc (Euro) and the CFA Franc, (ii) a guarantee of Convertibility extended to the CFA Franc through the operation account mechanisms open to the French treasury, and (iii) centralization of external assets through the French treasury followed by harmonization of exchange regulations within countries of the Franc Zone and outside for countries outside the Zone. Through these mechanisms, France confers credibility on its commitments by exercising the necessary control for the conduct of monetary policy in the countries of the Franc Zone. For their part, the countries of the Franc Zone undertake to follow a monetary policy based on price stability, shrinkage in the financing of budget deficits, prudent management of credit to the economy, and the aspiration towards a balance of overpayment.

Many economists agree that the monetary discipline of monetary co-operation agreements has allowed these countries to achieve low and stable levels of inflation relative to rates in other African countries outside the Zone (see, Honohan 1992, Assané and Pourgerami 1994, Neuven 1994, Lowrey 1995, Ghosh et al., 2008 and Coulibaly and Devis, 2014). This monetary discipline is even more apparent by comparing the evolution of the French inflation rate with that of the countries of the Franc Zone. To this end, Honohan (1992) uses quarterly data from 1960 to 1988 to establish a long-term stable relationship between these two types of rates and points out in the process that there is a one-way causal relationship ranging from the French inflation rate to the rates of the countries of the Franc Zone. But Savvides (1996) notes that in the short term there is a real diversity between the rates of these countries. On the analysis, these monetary cooperation agreements also have limits. The fixed exchange rate regime implies that the countries of the Franc Zone will abandon the use of the nominal exchange rate as an instrument of monetary policy by transferring it to a monetary institution of another country, in particular, France or the European Union. A long-term imbalance in the real exchange rate may have non-negligible effects on the economies of the countries of the Franc Zone. This is the case, for example, between the 1960s and 1975s when the countries of the Franc Zone benefited from the external competitiveness of their products and sustained economic growth. On the other hand, from the mid-1980 onwards, the lasting overvaluation of the CFA Franc and successive devaluations of the currencies of neighboring countries, Ghana, Nigeria, the Gambia, etc., will have the opposite effect by weakening the external competitiveness of these countries, resulting in a severe economic crisis. Testing for corrections such as the reduction of public budgets, price controls, import or export taxes, etc., will prove to be inefficient and costly (see Hounsou,2014). Finally, the inevitable correction of the exchange rate on 12 January 1994 will be accompanied by adjustment programs aimed at restoring external competitiveness and internal efficiency of economic sectors through monetary and fiscal discipline (see, in particular, Clément et al...1996).

In light of the historical links between France and the countries of the Franc Zone, Mundell (1972) draws conclusions from the monetary experience of sub-Saharan African countries, which he directly links to the monetary and financial practices of the former metropolises: Great Britain and France. The British tradition which calls for monetarist activism and experimentation has, according to Mundell (1972), allowed its former colonies in Africa to possess a higher level of development of monetary and financial institutions than their counterparts, ex French colonies, which adhere to the passive nature of monetary policy and the stability of exchange rates advocated by the former metropolis. Mundell (1972) verifies this conjecture with simple descriptive statistics that indicate that the propensity to hold cash or money, a sign of delay in the monetary and financial system, is more preponderant in the economies of the former colonies French and British. Abundant in the same sense as Mundell (1972), and while using more of indicators of monetary and financial development, Assané and Malamud (2010) confirm this conjecture using econometric models.

3. Empirical model

The traditional macroeconomic theory of money demand suggests that income, an indicator of economic activity and the interest rate, the opportunity cost of holding money, are the determinants of the demand for money. But for small economies such as the Franc Zone countries, such a specification may be limited and lead to erroneous conclusions dealing with domestic "patrimony" as the only substitute for money as an instrument reserve of value. In the current environment of globalization, a country's monetary policy may affect the supply or demand for money of another country. It is, therefore, necessary to formulate a function of money demand in the open economy to include both internal and external variables.

This is the case of empirical studies which deal with the recent monetary policy experience of the countries of the Franc Zone. Rother (1998) shows that from 1973 to 1996 the demand for money in WAEMU countries was stable for M1 but not stable for M2. Its model uses income and interest rates as internal explanatory variables, while the external explanatory variables include the difference between the interest rate of France and that of the countries of the Franc Zone and the change in the real exchange rate of the CFA Franc against the US dollar. Shortland and Stasavage (2004) note that in the recent conduct of interest rate policy, the BCEAO relied on economic indicators such as inflation, changes in income, claims on the government, and the level of external assets. Sugimoto (2001) uses a staggered dynamic model to conclude that the demand for money (M1) has been stable in each Zone and for both areas united. He also points out that for the period before 1994 the two Monetary Union Areas functioned as if they were a single Zone. On the other hand, since the devaluation in 1994 a divergence has emerged due to the different objectives of stabilization policy pursued by each central bank. Finally, Rother (1999) uses the quarterly series from 1975 to 1999 to study the demand for money in the broad sense for six WAEMU countries, excluding Côte d'Ivoire on the one hand, and on the other hand integrating it with the other WAEMU countries. As a result of this study, the demand for money has been stable in these different cases, but Côte d'Ivoire appears to be structurally different from the other six countries of the Union, which raises a methodological problem of aggregating the series when it is to study the behavior of the money demand function in the WAEMU as a whole.

The model that we propose in this study is that of a function of demand for money in open economy specified in panel and expressed in logarithm neperian (ln).

$$(m - p)_{it} = \alpha + \eta_i + \theta_t + \beta_1 y_{it} + \beta_2 \pi_{it} + \beta_3 cr_{it} + \beta_4 \sigma(ex)_{it} + \beta_5 i^*_{it} + \varepsilon_{it} \qquad (1)$$

where $(m - p)_{it} = \ln (M / P)_{it}$ is the real money supply in the strict sense $(m_1 - p)_{it}$ or in the broad sense $(m_2 - p)_{It}$; P_{it} is the price level, $y_{it} = \ln (Y / P)_{it}$ is the real GDP; $\pi_{it} = \ln (P_{it} / P_{it-1})$ is the inflation rate; $cr_{it} = \ln (cr / Y)_{it}$ is the ratio of credit (CR) to the economy on GDP; $\sigma(ex)_{it}$ is the variation (standard deviation) of the real exchange rate of the CFA Franc against the US dollar. The variable $(ex)_{it} = \ln [e (P^* / P)]_{it}$ is defined as the ratio of external prices (P *) to internal prices (P) weighted by e, the nominal exchange rate of the CFA Franc. Finally, the variable $I^*_{it} = \ln (R^f / R)_{it}$ is the differential of the interest rate on deposits in France (R^f) and that of each country in the Franc Zone (R). We consider a panel of observations on (i = 14) countries in the Franc Zone and t periods from 1985 to 2015. The coefficient η_i takes into account the heterogeneity of the member countries of the Franc Zone; Θ_t is the shock common to all countries whereas ε_{it} is the global residual of the model.

The monetary aggregate m_1 includes the sum of banknotes, coins in circulation, and deposits, while m_2 includes in addition to m_1 quasi-money, that is, term deposits. In general, the choice of monetary policy is based on m_1 if the objective is to analyze the stabilizing effect of the intermediate aggregates of transactions on the demand for money, and on m_2 if the emphasis is on the ends of speculation to which It is assumed that there is arbitrage between money

and financial assets, including domestic and foreign bonds, savings accounts, and investments in mutual funds. It is, therefore, important to incorporate these two aggregates into our model to determine which of the two measures the monetary authorities of the Franc Zone must control. For the analysis, we retain three internal explanatory variables *[y, π,* and *cr*] and two external explanatory variables [*σ (ex)* and *I *]*.

3.1 Internal variables

The current scale variable, y_{it} is measured by real GDP. It takes into account the demand for money for reasons of transactions and precautions. Cash holdings are therefore directly related to current real income. The variable p_{it} is the index of consumer or production prices. In developing countries, the absence of developed financial markets and the tendency by the monetary authorities to manipulate the interest rate have led many studies to focus on the inflation rate, the opportunity cost of real cash balances (Sugimoto,2001; Fry, 1988). Economic agents substitute real wealth (land, real estate) for real cash balances as wealth in the face of inflationary surges. Money demand studies in developing countries have often used the variable c_{it} as a measure of the degree of credit constraint in the economy. A restrictive credit policy, For example, has the unfortunate consequence of raising the interest rate. Wong (1977) uses a range of variables to apprehend the extent of the degree of credit constraint on the economy. Yahot (2003) attributes the liquidity crisis of the Ivorian economy from 1980 to 1990 to the restrictive monetary policy practiced by the BCEAO through a debtor interest rate deemed "prohibitive." In contrast to these studies, we use the cr_{it} variable as a measure of the degree of financing of credit to the economy. A direct relationship between credit and the demand for real cash is therefore anticipated. This is the case, for example, in the context of the financing of agricultural campaigns in which close links are established between credit and money supply. This is also the case when there is an expansion of the banking sector which leads to an increased monetization of the economy. Viewed in this way, the variable cr_{it} is like y_{it}, a variable of current scale but also takes into account the seasonal fluctuations in the economic activity of the countries of the Franc Zone.

3.2 External variables

The change in the real exchange rate *σ (ex*) serves as an opportunity cost indicator to hold the CFA Franc about foreign currencies and thus reflects the need for portfolio diversification. An overvaluation of the CFA Franc against the US dollar increases the opportunity cost of holding real cash balances, and in this case, the real exchange rate has negative effects on the demand for money. Finally, with regards to i^*_{it}, an upward deviation from this ratio encourages diversification of the portfolio of the economic agents of the Franc Zone to the benefit of external assets. Indeed, the stable and controlled interest rate policy practiced for a long time by the BCEAO and the BEAC and the free transfer of capital have, according to Bourdin (1980), contributed "to a drift of [Zone] savings toward the France. It is therefore anticipated that *i ** and the demand for real cash balances will be negatively correlated.

3.3 Estimation method

The use of panel data has become increasingly important in empirical studies (see, for example, Baltagi, 2001, Wooldridge, 2002, and Mignon, 2004). For a group of units (countries, industries, households, etc.), panel data includes both snapshot and time series data. Therefore, panel data offers more varied information that is useful in strengthening the effectiveness of statistical tests such as unit root or cointegration tests.
To test the stability of the demand for money, an abundance of recent studies has relied on panel data and econometric techniques of non-stationary time series. In general, a time series is said to be non-stationary or has a unit root if the distribution of the series does not change over time. Consequently, a stationary time series leads one to believe that the future behaves like the past, at least in "probabilistic" term. Non stationary time series produce estimators, statistical tests, and erroneous predictions, as is the case with spurious regressions. Also, the cointegration concept stems from non stationary time series. Indeed, two series are said to be cointegrated if they are both non-stationary, but their linear combination is stationary. We briefly present these two types of tests as part of the panel data.

3.3.1 Unit Root Tests

The most commonly used unit root tests are based on the work of Levin, Lin, and Chu (2002) and Im, Pesaran and Shin (2003). These two tests result from the unit root test of the

Augmented Dickey-Fuller series (ADF) based on the following equation:

$$\Delta Z_{it} = \rho_i Z_{i,t-1} + \sum_{j=1}^{p} \theta_{ij} \Delta Z_{i,t-j} + \alpha_i + \varepsilon_{i,t} \qquad (2)$$

Where Zi_t is the variable of choice, εi_t is the residue which is white noise, with i = 1, ..., N, representing the individual elements of the panel, and t = 1, ..., T, the temporal dimension. The null hypothesis: H0: = 0, $\forall i$ indicates that Z_{it} is nonstationary and therefore cannot converge. On the other hand, the alternative hypothesis*: H_1: <0* is that Z_{it} converges. Levin, Lin and Chu (2002) impose an identical convergence of the individual elements ($\rho_1 = \rho_2 = \ldots = \rho_i = \rho$), that is they converge at the same rate. On the other hand, Im, Pesaran, and Shin (2003) relax the hypothesis of identical convergence, which makes it possible to envisage a heterogeneity of ρ, which can be adjusted at different levels.

3.3.2 Cointégration Tests

We use two cointegration tests adapted to empirical panel data studies. These tests are by Pedroni (1999, 2001) and Kao (1999). First, Pedroni examines the characteristics of spurious regressions to suggest cointegration tests related to residual series. It proposes seven types of statistical tests divided into two categories. The first group consists of four tests based on the within (intra) dimension that analyze the intra-individual correlations of the residual series. These tests are the test-*v* panel, the test-*ρ* panel, the test-*PP* panel and the test-*ADF*. The first three tests are nonparametric and similar to the unit root test of the individual series of Phillips-Perron (1998). The last test is parametric and similar to the *ADF* test. The other group of tests consists of three tests based on the Between (inter) dimension to take into account inter- individual correlations of the residual series. These tests are the test-*v* panel, the test-*ρ* panel, the test-*PP* panel and the test-*ADF*. Like in the previous case, the first two tests are nonparametric whereas the last test is parametric and similar to the test of Im, Pesaran, and Chu (2003). The characteristics of these tests are as follows: the null hypothesis assumes that the residuals are non stationary, that is to say, that there is no cointegration relation between the variables used. The alternative hypothesis, on the other hand, suggests the stationarity of the residues and therefore the existence of the cointegrated relations between the variables.

Then, the Kao test (1999) follows the same ADF type cointegration principles based on regression residuals. In particular, Kao (1999) uses cointegration vectors supposed to be homogeneous between individuals. The null hypothesis assumes that the residuals are stationary, whereas the alternative hypothesis shows that the residuals are stationary and in this case there exist cointegration relationships between the variables.

3.3.3 Model Estimation

To estimate the long-run equilibrium relations of the money demand function (Equation 1) in the Franc Zone, we use three econometric methods: The Ordinary Least Squares (OLS), the Fully Modified Ordinary Least Squares (FMOLS), and the Dynamic Ordinary Least Squares method (DOLS). In the presence of heterogeneous panels, the characteristics of these methods are as follows: the OLS method confers slope coefficients which are consistent but suffer from the problems of endogeneity of the regressors and problems of serial correlation of the residuals. Alternative FMOLS methods by Phillips and Hansen (1990) and Pedroni (1999) and DOLS by Saikkonen (1991) and Stock and Watson (1993) produce robust estimators regardless of the size of the sample used. Also, the FMOLS and DOLS estimators are non-biased and converge asymptotically to the normal, centered, and reduced law. Also, both correct methods problems of regression endogeneity and problems related to autocorrelation and heteroscedasticity generally associated with panel data.

3.4 Characteristic data

The data of our study cover the period 1985-2015 and are extracted from the electronic sources of the databases of the World Development Indicators of the World Bank which are concordant with the various Reports of the BCEAO and the BEAC. We briefly present the practical definitions of the variables of our empirical model. The money supply is represented in the strict sense by m_1 and in the broad sense by m_2. GDP measured income at the current price in 2005. Also, based on the year 2005, two price indices are used: consumer price indices and GDP price indices. The inflation rates derived from these prices are constructed as the first difference of the logarithm. Credit variable cr_{it} is measured by the ratio of credit to the private sector on GDP. As for the elements *e (P * / P)* which help to construct the variation of the real exchange rate *σ (ex)*, we retain that *e* is the nominal exchange rate of the countries of the Franc Zone against the US dollar, *P ** Is the consumer price index of the United States, while *P* is the index of consumer or production prices of each country in the Franc Zone. Finally, *i ** is the difference between the rate of interest on the deposits of the commercial banks of France and that of the commercial banks of the countries of the Franc Zone. As is often the case in developing countries, we observe that data are not always available over a period for some

countries in the Franc Zone. The tendency has been to omit these countries from econometric studies and to conclude from the "biased selection" of countries that are rich in data (see to this effect, Honohan, 1992).Based on the availability of data from the Franc Zone countries, the choice of the study period is important. We are assured of a better availability of continuous data from 1985 to 2015.

4. Analysis of results

To study the long-term relationships of the time series of panel data we use, two tests are successively applied: unit root tests and cointegration tests.

4.1 Results of unit root tests

Table 1 contains the results of the panel unit root tests of Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003). The first column of the table gives the results of the series in level and the second column illustrates the results when the series are differentiated.

Table 1: Unit Root Tests of Panel Series

Series	Methods	Level	Difference
m_1	Levin, Liu and Chin	2, 683	-7, 697 ***
	Im, Peseram, and Sin	2, 407	-8, 650 ***
m_2	Levin, Liu and Chin	-0,471	-8, 401 ***
	Im, Peseram, and Sin	0,407	-7, 821 ***
y	Levin, Liu and Chin	-0, 2.74	-6, 081 ***
	Im, Peseram, and Sin	1, 794	-7, 548 ***
p	Levin, Liu and Chin	-0, 321	-9, 097 ***
	Im, Peseram, and Sin	2, 978	-7, 192 ***
π	Levin, Liu and Chin	-8, 455 ***	
	Im, Peseram, and Sin	-6, 377 ***	
cr	Levin, Liu and Chin	-1, 259	-5, 355 **
	Im, Peseram, and Sin	0, 757	-6, 807 ***
σ *(ex)*	Levin, Liu and Chin	-0, 707	-5, 662 ***
	Im, Peseram, and Sin	-0.411	-3, 417 ***
*i**	Levin, Liu and Chin	-2, 373 ***	
	Im, Peseram, and Sin	-3, 918 ***	

The asterisk (***) indicates that the value is statistically significant at the 1% significance level.

The results of the unit tests are consistent with the unit root tests in most macroeconomic series. Also, the results reveal characteristics that are specific to the countries of the Franc Zone. We observe that the series m_1, m_2, *y*, *cr* and σ *(ex)* admit unit roots in level, but become stationary in first difference. In other words, these series are integrated of order *1, I (1)*. Moreover, the series π and *i* * have no unit root in level and therefore are *I (0)*, *i.e.*, they are stationary in level. These last two results are not surprising insofar as (I) inflation is only a price transformation in the first difference and (ii) the stationarity of *i* *,-the difference between the interest rate on the deposits in France and that of the countries of the Franc Zone is, but another manifestation of monetary discipline in the Franc Zone, which is capped by France. In this case, there is a tendency in the long term for the convergence of the two rates.

4.2 Results of cointegration tests

Tables 2 and 3 contain all the results of the cointegration tests of Pedroni (1999, 2001) and Kao (1999). Table 2 presents the results of the equation of the money demand function with (m_1-p) as the money supply, while Table 3 shows the results related to the money supply (m_2-p).

Table 2: Panel Cointegration Test of Variables
[m_1-p, y, π, cr, σ (ex), i *]

I. Cointegration tests of Pedroni residues

A. Panel Tests: Intra-Individual (Intra)

Statistical υ panel:	-0, 778
Statistics ρ PP of panel:	2, 337 **
Statistics t PP panel: -4,	223 ***
Statistics t Panel ADF:	-3, 324 ***

B. Panel Tests: Inter-Individual Dimension (Inter)

Statistics ρ Group PP:	3, 630 ***
Statistics t Group PP:	-5.659 ***
Statistic t ADF group:	-3, 502 ***

II. Kao Residue Integration Test

Test – Statistics : -3, 755 ***

The asterisks (**) and (***) indicate that the values are statistically significant at significance thresholds of 5% and 1%, respectively.

Table 3: Panel Cointegration Test of Variables

[m_2-p, y, π, cr, σ (ex), i *]

I. Cointegration tests of Pedroni residues

A. Panel Tests: Intra-Individual (Intra)

Statistical υ panel:	-1, 187
Statistics ρ PP of panel:	2, 799 ***
Statistics t PP of panel:	1, 756 **
Statistic t ADF of panel:	0, 425

B. Panel Tests: Inter-Individual Dimension (Inter)

Statistic ρ Group PP:	4, 302 ***
Statistic t PP of group:	-3, 721 ***
Statistic t ADF of group:	3, 502 ***

II. Kao Residue Integration Tests

Test - Statistics: -8, 752 ***

The asterisks (**) and (***) indicate that the values are statistically significant at significance thresholds of 5% and 1%, respectively.

In general, the results of the tables are coherent and lead to the conclusion that there is a cointegration relation between the variables used. More specifically, compared with Table 2, six out of seven tests in Pedroni (1999, 2001)

are significant, while five out of seven tests are reported in Table 3. For Kao (1999), the results of both tests are highly significant at the 1% level.

From the cointegration relations of the money demand functions *(m_1-p)* or *(m_2-p)*, we can present the results resulting from the estimation of these functions using the estimators OLS, FMOLS, and DOLS.

4.3 Analysis of empirical results

Tables 4 and 5 combine the regression results of the specifications (m_1-p) and (m_2-p), respectively. We can first note that the signs of the estimated coefficients of all the variables used are consistent in a sense anticipated by economic theory. In this case, any increase in income (*y*) or credit (*cr*) results in an increase in the demand for money in the sense of (*m_1-p*) or (*m_2-p).* On the other hand, an increase in the price expressed as inflation (π), the difference between the two interest rates (i *), or the change in the real exchange rate, σ (*ex*), contributes to the decline in the demand for money. The significance of the coefficients by the student-t test is robust at the 1% threshold. Similarly, the adjusted coefficient of determination and the F-statistical tests indicate that the various specifications are good. In total, using the OLS, FMOLS, and DOLS estimators, the empirical results lead to a consistent diagnosis. On the basis of panel data, the internal explanatory variables (*y*, π and *cr*) and external explanatory variables (σ (*ex*) and *i* *) are not only significant components of the two demand for money functions, but they contribute significantly to the stability of these functions within the institutional framework of the Franc Zone.

Table 4: Results of model regression:

$$[m_1 - p = \alpha + \theta t + \eta i + \beta 1 + \beta 2\ cr + \beta 3\ \pi + \beta 4\ i^* + \beta 5\ \sigma\ (ex) + \varepsilon]$$

Variables	OLS	FMOLS	DOLS
y	1,103 ***	1,093 ***	1,046 ***
	(3,87)	(3,172)	(3,341)
cr	1.026 ***	1.011 ***	1.024 ***
	(7.041)	(5.640)	(6.345)
π	-0.025 ***	-0.012 ***	-0.019 ***
	(-5.90)	(-6.012)	(-5.761)
i *	-1,247 ***	-1,187 ***	-1,243 ***
	(-4.170)	(-3.215)	(-3.712)
σ (ex)	-0.034 ***	-0.012 **	-0.042 **
	(-2.905)	(-2.321)	(-2.265)
Time Effects	*Yes*	*Yes*	*Yes*
Effects of heterogeneity	*Yes*	*Yes*	*Yes*
R^2-adjusted	*0, 663*	*0.603*	*0.611*

The values of Student's t are in parentheses. The asterisks (**) and (***) correspond to the statistical significance at the thresholds of 5% and 1%, respectively. Regressions have fixed individual effects that are not reported here.

Table 5: Model regression results

$$[m_2 - p = \alpha + \theta t + \eta i + \beta 1 + \beta 2\ cr + \beta 3\ \pi + \beta 4\ i^* + \beta 5\ \sigma\ (ex) + \varepsilon]$$

Variables	OLS	FMOLS	DOLS
y	1, 223 ***	1.365 ***	1.264 ***

	(6,35)	(6,043)	(5,334)
cr	1, 453 ***	1,247 ***	1,232 ***
	(11,460)	(8,345)	(8,769)
π	-0, 125 ***	-0, 109 ***	-0, 101 ***
	(-4.118)	(-3.786)	(-2.986)
i *	-1,986 ***	-1,476 ***	-1,264 ***
	(-4.660)	(-3.423)	(-3.618)
σ (ex)	-0,042 ***	-0,028 ***	-0,051 ***
	(-3.013)	(-2.902)	(-2.913)
Time Effects	*Yes*	*Yes*	*Yes*
Effects of heterogeneity	*Yes*	*Yes*	*Yes*
R^2*-adjusted*	*0, 710*	*0.702*	*0.711*

The values of Student's t are in parentheses. The asterisk (***) corresponds to the significance of the statistic at the threshold of 1%. Regressions have fixed individual effects that are not reported here.

After the significance of the estimated coefficients presented in Tables 4 and 5, we can now estimate the weight of these coefficients depending on whether the variables reflect economic activity (*y* and *cr*) or the opportunity cost (π, *i* *, and σ *(ex)*). We first notice that the elasticities of the variables of economic activity are greater than 1, making money a luxury good. About opportunity costs, the demand for money is very sensitive to the variation in the interest rate differential between France and the countries of the Franc Zone. On the other hand, we observe low semi-elasticities of the inflation rate and the change in the real exchange rate. For these two latter rates, we should expect such results in the context of the Franc Zone where the discipline of monetary policy makes inflation a negligible concern. The same is true for the tiny semi-elasticity of the change in the real exchange rate, which corresponds to the logic of the Franc Zone, which is capped by France whose strong and convertible currency (Euro) serves as an anchor for the CFA Franc. Finally, as we should expect, the slope weights of the specification (m_2 - *p*) are relatively wide in absolute value about those of the specification (m_1 - *p*). Thus, the m_2 aggregate appears as the ideal indicator to be followed by the BCEAO or the BEAC in the conduct of monetary policy.

5. Discussion and Conclusion

The purpose of this study was to analyze the determinants and behavior of the money demand function in the narrow sense (m_1- *p*) and in the broad sense (m_2- *p*) in the Franc Zone. The study uses panel data covering the period 1985-2015 for the Franc Zone which includes the WAEMU and CAEMU countries. The two functions of demand for money retained concern open economies with internal explanatory variables that are the real GDP, the credit to the economy, and the inflation rate. The external explanatory variables are described by the difference between the interest rates on deposits in France and the Franc Zone countries and by the change in the real exchange rate to the US dollar. The main econometric results are summarized in four points.

First, the explanatory variables exert significant effects on (m_1 - *p*) or (m_2 - *p*). They are mostly non-stationary in level, but there is a cointegration relationship between them. Thus, despite an uncertain economic environment and sustained reform programs that influence the direction of monetary policy, it appears that the behavior of economic agents regarding real cash holdings has not changed.

Second, the empirical results based on the OLS, FMOLS, and DOLS estimators are consistent. The signs of the estimated coefficients are consistent with economic theory, the coefficients themselves are statistically significant at least at the conventional level of 5%, and the adjusted coefficients of determination reinforce the significant effects of the explanatory variables on (m_1 - *p*) or (m_2 - *p*).

Third, the signs and magnitudes of the coefficients show that the real GDP and credit to the economy variables are positively correlated to (m_1 - *p*) or (m_2 - *p*), and elasticities are above 1 making money a luxury good. On the other hand, the opportunity costs of real cash balances are largely influenced by the difference between the interest rates on deposits in France and the countries of the Franc Zone. On the other hand, inertia is observed when it comes to the rate

of inflation and the real exchange rate. In absolute terms, the magnitudes of the coefficients of the specification (m_2-p) are for the most part superior to that of (m_1 - p). This makes the monetary aggregate m_2, the indicator preferred by the BCEAO or the BEAC in the conduct of monetary policy.

Finally, unlike empirical studies based on time series, which are limited only to countries that are rich in data from the Franc Zone and which sometimes offer only ambiguous conclusions, the panel data approach here has advantages for our analysis. It treats the Franc Zone in its specificity where member countries are subject to common factors specific to the Zone. Moreover, it provides robust statistical tests that attest to the usefulness and effectiveness of the econometric analysis of panel data of non-stationary variables in the institutional framework of the Franc Zone. Taking into account the results may lead the BCEAO or the BEAC to conduct a simple monetary policy depending on whether the explanatory variables are sensitive to the demand for real cash. In this perspective, the two central banks would be more attentive to the indicators of transactions in the economy measured by real GDP or the level of credit to the economy and by the divergence in interest rates on deposits in France and Countries of the Franc Zone. In the latter case, it should be pointed out that with the current reforms of interest rate liberalization through indirect monetary policy instruments in the Franc Zone countries we should see a tendency towards the convergence of both rates as seems to indicate the stationarity tests. Still, in the long run, central banks would be less concerned about the rate of inflation and the real exchange rate, which are dependent on the disciplinary and credible effects of the institutional framework of the Franc Zone.

The approach of this study ignores the stability behavior of the short-term dynamic model. The other omission concerns the stability of the estimates at the disaggregated level of the WAEMU or CAEMU monetary sub-areas. Two particularly important topics that could be the subject of future research

References

Assané D., Pourgerami A. (1994). "Monetary Co-Operation and Economic Growth in Africa: Comparative Evidence from the CFA Zone Countries," *Journal of Development Studies*, 30, pp. 423-442.

Assane, D., Malamud, B. (2010). "Financial development and growth in Anglophone and Francophone Sub-Saharan Africa: Do legal origin and CFA Membership Matter? " *Applied Economics*, 42, pp. 2683-2697.

Baltagi, B. (2008). *Econometric Analysis of Panel Data: John Wiley & Sons.* 4th edition.

Bourdin J. (1980). *Monnaie et Politique Monétaire dans les Pays de la Zone Franc.* Les Nouvelles Editions Africaines.

Clément, J.A., Mueller J., Cossé S., Le Dem J.(1996). *Aftermath of the CFA Devaluation*. IMF Occasional Paper No. 138, International Monetary Fund, Washington DC.

Coulibaly, I. and Davis, J. (2014) "Exchange Rate Regimes and Economic Performance: Does CFA Zone membership Benefit their Economies? ", *MPRA Paper No. 54075.*

Fry M. J. (1988). *Money, Interest, and Banking in Economic Development.* The Johns Hopkins University Press. Baltimore.

Ghosh, A. R., Gulde, A. M., and Wolf, H. C. (2008) "Monetary Union in Central and Western Africa," *Journal of Financial Transformation, 20: 175-189.*

Hayek F. (1960). *The Constitution of Liberty*. The University of Chicago Press, Chicago.

Honohan P. (1992). "Price and Monetary Convergence in a Currency Union: The Franc and Rand Zon," *Journal of International Money and Finance*, 11, pp. 397-410.

Hounsou Rémy (2014), "Régimes de Taux de Change Fixes et Flexibles en Zones Franc CFA et non Franc: Une Etude Comparative à travers la Discipline Budgétaire", *Revue d'Economie Théorique et Appliquée, Volume 4 - Décembre* 2014, pp 163- 180.

Huang H., Wei S.J. (2006). "Monetary Policies for Developing Countries: The Role of Institutional Quality" *Journal of International Economics*, 70, pp. 239-252.

Im K.S., Pesaran M.H., Shin Y.(2003). "Testing for Unit Root in Heterogeneous Panels," *Journal of Econometrics*, 115, pp. 53-74.

Kao C. (1999). "Spurious Regression and Residual-Based Tests for Cointegration in Panel Data", *Journal of Econometrics*, 90, pp. 1-44.

Koulibaly M.(1992). *Le Libéralisme : Nouveau Départ pour l'Afrique Noire*. L'Harmattan.

Levin, A., Lin C.F., Chu C.S.(2002). "Unit Root Test in Panel Data: Asymptotic and Finite-Sample Properties" *Journal of Econometrics*, 108, pp. 1-24.

Lowrey, M. (1995). " France and the CFA: Price and Money Supply Growth Determination: 1969-1988 ", *Journal of African Economies*, 4, pp. 225-242.

Mignon, V. (2004). "Tests de Racine Unitaire et de Cointégration sur Données de Panel: Une Revue de la literature", *Manuscript.* THEMA, Université Paris X-Nanterre.

Mundell R. (1972). «African Trade, Politics, and Money» dans *Africa and Monetary Integration* (eds), R. Tremblay, HRW, Montréal, pp. 11-67.

Neuven D. 1994. «Linkage in Price Level and Inflation Rate between CFA Franc Zone Countries and France,» Working Paper, 93, Washington DC: International Monetary Fund.

Nguessan T. (1996). *Gouvernance et Politique Monétaire: A qui Profitent les Banques Centrales de la Zone Franc?* L'Harmattan.

Parmentier J.M., Tenconi R. (1996). *Zone Franc : Fin d'une* Ère *ou Renaissance*. L'Harmattan.

Pedroni, P. (1999). "Critical Values for Cointegration Test in Heterogeneous Panels with Multiple Regressions," *Oxford Bulletin of Economics and Statistics*, 61, pp. 653-670.

Pedroni, P. (2001). "Purchasing Power Parity Tests in Cointegrated Panels," *Review of Economics and Statistics*, 61, pp. 727-731.

Phillips, P.C., Perron, P. (1988), "Testing for Unit Root in Time Series Regression," *Biometrika*, 75, pp. 335-346.

Phillips P.C., Hansen, B.E. (1990). "Statistical Inference in Instrumental Variables Regression with I(1) Process", *Review of Economic Studies*, 57, pp. 99-125.

Poole, W. (1970), "The Optimal Choice of Monetary Policy Instruments in a Simple Macro Model," *Quarterly Journal of Economics*, 84, pp. 197-216.

Rother P.C.(1998). "Money Demand and Regional Monetary Policy in the West African Economic and Monetary Union," Working Paper, 57, Washington DC: International Monetary Fund.

Rother P.C. (1999). "Monetary Demand in the West African Economic and Monetary Union -The Problem of Aggregation," *Journal of African Economies*, 8, pp. 442-447.

Saikkonen, P. (1991). "Asymptotically Efficient Estimation of Cointegrating Regressions," *Econometrica*, 58, pp. 1-21.

Sedemo S., Villieu P.(1997). *La Zone Franc: Mécanisme et Perspectives Macroéconomiques.* Ellipse.

Savvides, A. (1996). "CFA Franc Zone Membership and Exchange Rate Variability,"*Journal of African Economies*, 5, pp. 52-68.

Sugimoto, K. (2001). "One Money or Two Monies? Monetary Policy in the CFA Franc Zone, 1968-1993" *Journal of African Economies*, 10, pp.64-91.

Shortland, A., Stasavage D. (2004). "What Determines Monetary Policy in the CFA Zone?

Estimating a Reaction Function for the BCEAO", *Journal of African Economies*, 13, pp. 518-535.

Stock, J, Watson, M. (1993). "A Simple Estimator of Cointegrating Vectors in Higher Order Integrated System," *Econometrica*, 61, pp. 783-820.

Tchundjand J.P. (1980). *Monnaie, Servitude et Liberté : La Répression Monétaire de l'Afrique*. Les éditions Jeune Afrique.

Wong C.H. (1977). "Demand for Money in Developing Countries: Some Theoretical and Empirical Results," *Journal of Monetary Economics*, 3, pp. 59-86.

Wooldridge A.J. (2002). *Econometric Analysis of Cross Section and Panel Data.* Cambridge, MA: MIT Press.

Yahot A.D. (2003). *La Crise de Liquidité dans l'Economie Ivoirienne des Années 1980-1990*, Thèse de Doctorat : Université, Paris-Versailles (non publiée).