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Optimality of a monetary union: New evidence from exchange rate misalignments in West Africa♦

Issiaka Coulibaly* and Blaise Gnimassoun**

Abstract: This paper aims to study the optimality of a monetary union in West Africa by using a new methodology based on the analysis of convergence and co-movements between exchange rate misalignments. Two main advantages characterize this original framework. First, it brings together the information related to several optimum currency area criteria—such as price convergence, terms of trade shocks, and trade and fiscal policies—going further than previous studies which are mainly based on only one criterion at a given time. Second, our study detects potential competitiveness differentials which play a key role in the debate on the optimality or not of a monetary union, as evidenced by the recent crisis in the Euro area. Relying on recent panel cointegration techniques and cluster analysis, our results show that the WAEMU area has a core composed by Burkina Faso, Mali, Niger and Senegal which can be joined by Ghana, Sierra Leone and, to a lesser extent, Gambia, and that Ghana and Senegal appear to be the best reference countries for the creation of the whole West Africa monetary union.

Keywords: Exchange rate misalignment, Optimum Currency Area, West African countries.

JEL Classification: F31, F33, O1.

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INTRODUCTION

In recent years, there has been a renewed interest in analyzing monetary unions in Africa, especially with the project of the countries belonging to the Economic Community of West African States (ECOWAS) to form a new monetary union. The ECOWAS was established in 1975 in order to promote cooperation and economic integration in West Africa.[1] Noting the mitigated progress in terms of economic integration, ECOWAS leaders have quickly thought about the creation of a single currency to meet their goals. From 1983, several projects have been established (see section 1.1), but they have been unheeded until the successful launch of the Euro in 1999. These projects have been revived through the establishment of convergence criteria, in 2000, whose achievements are decisive for the creation of the future monetary union.

In this paper, our aim is to contribute to this debate by analyzing the optimality of forming a monetary union in West Africa. An abundant literature[2], generally based on the optimum currency area (OCA) criteria, has investigated the relevance of a monetary union within the ECOWAS area. These studies highlight the heterogeneity of West African countries, and generally conclude that one of the main problems of forming a monetary union is the inclusion of Nigeria. Indeed, the latter—which is the main economy and the most populous country of the ECOWAS (around 60% of the revenue and 52% of the population)—is structurally very different from other countries of this area. Consequently, the benefits of the ECOWAS monetary union should be considered with caution especially for WAEMU countries. Indeed, the expected gains for WAEMU countries, which record low inflation rates, should be lesser than those of the other area members (see De Grauwe, 1996 or Debrun et al., 2005). However, most of this previous literature is based on only one OCA criterion, leading

[1] ECOWAS area is actually composed by fifteen countries: eight West African Economic and Monetary Union (WAEMU) countries which share the same currency named "CFA franc", and the others that have each their own currency.
The WAEMU has as members Benin, Burkina Faso, Guinea Bissau, Ivory Coast, Mali, Niger, Senegal, and Togo. Its CFA franc, issued by the Central Bank of West African States, has been pegged to the French Franc and to the Euro since 1999. The convertibility of the CFA franc is however unlimited relative to the Euro and guaranteed by the France. In exchange, the CFA zone countries depose at least 65% (50% for the WAEMU, since 2005) of their foreign reserves in a special operating account held by the French Treasury.
The other ECOWAS countries are: Cape Verde, Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone. These countries, with the exception of Cape Verde and Liberia, stated their intention to create a new monetary union named West African Monetary Zone (WAMZ) before 2015. Thereafter, the WAMZ would merge with WAEMU in 2020 in order to build a monetary union of ECOWAS.
[2] See references in section 1.2.

frequently to contradictory results as evidenced by studies on supply and demand shocks or output and price convergence. This illustrates the "problem of inconclusiveness" highlighted by the literature on the OCA theory (see for instance, Tavlas, 1994 or Mongelli, 2008).

For facing these shortcomings, we go further than the previous studies by proposing a global indicator related to economic competitiveness which should play a key role in the debate on the optimality or not of a monetary union, especially after the recent crisis in the Euro area. More specifically, we focus on the similarities and dissimilarities of ECOWAS member states in terms of economic competitiveness through analyzing exchange rate misalignments, defined as the difference between the observed exchange rate and its equilibrium level. Since the equilibrium exchange rate is defined as the real exchange rate that allows an economy to reach its internal and external equilibriums, exchange rate misalignments constitute not only an indicator of a country economic competitiveness, but also a useful indicator of the viability of a monetary union.[3] Indeed, large differences in competitiveness between countries within a monetary union could lead to current imbalances, as evidenced by the recent experience of the Euro area (see Coudert et al., 2012).[4] In this context, it would be difficult for the common central bank to set up common and consensual policies (monetary and exchange rate), which in turn could challenge the stability of the union.

Consequently, we argue that a viable monetary union, which will be sustainable in the future, requires that countries forming this union should have close competitiveness levels. More specifically, we define as optimal a currency area in which economic policies are consistent and convergent. As real exchange rates affect and are affected by all other policies, we propose to test this optimality hypothesis by analyzing the behavior—convergence and co-movements—of the real exchange rate misalignments.

Turning to methodological issues, we rely on the Behavioral Equilibrium Exchange Rate approach (BEER) introduced by Clark and MacDonald (1998) to estimate the equilibrium exchange rate of ECOWAS countries and derive corresponding misalignments. Within this

[3] As misalignments are affected by many variables related to the OCA theory (price differences and economic fundamentals such as terms of trade shocks, trade and fiscal policies, productivity shocks, etc.) they can be viewed as an overall indicator of the viability of a monetary union compared to other OCA criteria. Moreover, Fielding (2005, pp. 12) argues the importance of the real exchange rate as well as that of the output and price shocks in analyzing the costs and benefits of a monetary union.

[4] Such a problem in the ECOWAS could easily lead to the collapse of the monetary union, since there is no natural leader, like Germany in the Euro area. Nigeria does not have credible monetary and budgetary policies since its inflation rate and budget deficits are higher than those of the WAEMU member states.

framework, the real equilibrium exchange rate is the solution of a long-run relationship between the real exchange rate and a set of macroeconomic fundamentals. To consistently estimate such long-run relationship, we use various recent panel cointegration techniques (Pool Mean Group, Dynamic OLS and Fully-Modified OLS estimators). We complement the investigation by a cluster analysis, allowing us to study similarities and dissimilarities of the CFA and WAMZ countries in terms of price competitiveness.

Using annual data over the 1985-2009 period, our results confirm the heterogeneity and the non optimality of the monetary unions in West Africa: CAEMC[5], WAEMU and WAMZ. Despite these differences, among these areas, WAEMU seems to be the most homogeneous area with high correlation between its member countries' competitiveness level. WAEMU has also core countries composed by Burkina Faso, Mali, Niger and Senegal which share some common characteristics. Relying on cluster analyses, we show that this core can be joined by Ghana, Sierra Leone and, to a lesser extent, by Gambia from the WAMZ area. Nigeria, which appears alone in the WAMZ zone, displays interesting similarities with CAEMC member countries calling for their merging. Finally, in the perspective of the creation of the monetary union of ECOWAS, we show that Ghana and Senegal would be the best references for the area since they are institutionally stable and economically relatively strong. In addition, these two countries' misalignments are positively correlated to those of most ECOWAS member states. By corroborating the main results of Bénassy-Quéré and Coupet (2008) and Tsangarides and Queshi (2008) which use several variables related to the OCA criteria, our paper evidences the relevance of our global indicator based on exchange rate misalignments to assess the optimality of a monetary union.

The remaining of the paper is organized as follow. Section 1 presents the background of the ECOWAS area and reviews the literature on its optimality. Section 2 describes the empirical methodology and presents the results of panel unit root and cointegration tests, as well as the estimation of the long-run relationship. In section 3, we analyze the behavior of exchange rate misalignments before concluding the paper.

[5] The Central African Economic and Monetary Community is the second monetary union of the CFA zone whose member countries are Cameroon, Central African Republic, Chad, Congo Brazzaville, Equatorial Guinea, and Gabon.

1. BACKGROUND TO THE ECOWAS AREA AND LITERATURE REVIEW

1.1. Background and state of convergence in the ECOWAS area

In the wake of their independence in the 1960s, Sub-Saharan Africa (SSA) countries have adopted different strategies in terms of exchange rate policy. Former British colonies have abandoned their currency boards to create their own currencies while the former French colonies decided to form a monetary union named "CFA franc zone". This situation, leading to the proliferation of non-convertible currencies, was seen as an obstacle to trade, integration and economic development. To promote regional integration, the Heads of States and Government of West Africa' countries decided, in 1975 in Lagos (Nigeria), to create the ECOWAS. Thus, they established a clearing house whose purpose was to facilitate the use of national currencies for the settlement of trade between the members of the community.

The idea of a single currency for the ECOWAS area was explicitly mentioned for the first time in 1983 in Conakry (Guinea). On this occasion, the ECOWAS monetary cooperation program (EMCP) was proposed[6] before being validated in July 1987. In the short run, the EMCP should contribute to improve and strengthen the mechanism of the clearing house. To this end, the clearing house was substituted, in 1996, by the West African Monetary Agency (WAMA) which brings together all the central banks of the ECOWAS. This autonomous agency is however charged to manage the EMCP and ensure the harmonization of monetary policy framework. In the long run, the program should ensure the limited convertibility between currencies of the ECOWAS member states and that of the future common currency. The features of the ECOWAS monetary union have been defined in this program, that is: management and pooling of all reserves, common monetary policy and common convertible currency, an agreement on the convertibility guarantee, etc. So, the only difference between the *ECO* and the CFA franc is the uncertainty about the anchor currency.

However, the EMCP has been unheeded until the successful launch of the Euro in 1999 that has brought renewed interest in its achievement. To give new impetus to the program, ECOWAS leaders have decided in December 2000 to opt for another strategy that they called "Accelerated Integration". This strategy had two phases: the creation in 2003 of a second

[6] This project is part of a larger project initiated, in 1963, by the OAU (Organization of African Unity replaced by the African Union AU) whose aim is to create a single currency for all Africa. In this perspective, an expertise mission was led by Pr. Robert Triffin whose report was published in BCEAO *information and statistics note n° 103*, February 1964. As suggested by Triffin's report, African Central Bank's Association was established in 1968 and five sub-programs around five African regions (North, South, East, Western and Central) were planed.

monetary union WAMZ whose common currency will be called "*ECO*", and the merging of the latter with the WAEMU in 2005. In this perspective, first order and second order convergence criteria have been defined. The first order criteria, whose achievements are decisive for the creation of the future monetary union, are: single digit inflation rate; budget deficit lower than 4%; external reserves greater than 3 months of imports and central bank financing of government budget deficit lower than 10% of previous year's tax revenue. Concerning second order criteria, they focus on the monetary and exchange rate policies management (positive interest rate and stable nominal exchange rate), and also on the structure of public accounts (no domestic arrears, tax revenue greater than 20% of GDP, salary mass lower than 35% of tax revenue, and public investment greater than 20% of domestic receipts). In addition, West African Monetary Institute (WAMI) has been created for working towards the establishment of conditions for the launch of the *ECO*. This institute is charged to carry out the multilateral surveillance of macroeconomic performance, establish the status of the Central Bank of West Africa, and design the architecture and policy frameworks of the WAMZ monetary union.

The lack of macroeconomic convergence has delayed the schedule. The launch date of the *ECO* has been postponed from 2003 to 2005 and to 2009. Taking into account the effects of the global economic crisis on their economies and mitigated progress in terms of macroeconomic convergence, WAMZ countries have finally decided to postpone the creation of the *ECO* to 2014. Indeed, before the economic crisis of 2008, achievements of first order criteria have been improved in comparison with the early 2000s (see table 1). On the 2005-2007 period, WAMZ economies registered their best performance in terms of macroeconomic convergence with more than 50% of criteria met. However, there is significant difference within the area. Two lowest economies of the area (Guinea and Sierra Leone) and Ghana have difficulty to meet the criteria, while Gambia and Nigeria have yet achieved all the first order criteria goals. A deeper analysis shows that inflation and budgetary deficit criteria are those that are struggling to realize for these economies. This could be problematic in the sense that inflation and budgetary deficit criteria are also the most important within a monetary union (see De Grauwe, 1996). In contrast, the criterion which has been easily reached on the 2001-2009 period is that of the foreign exchange reserves thanks in part to the increase in commodity prices over this period. Concerning the stability of the nominal exchange rate, only Nigeria succeeded to maintain its exchange rate in a fluctuation band of +/- 15%. The other economies have significantly adjusted their exchange rates to face shocks as those of recent crisis. The Gambia's nominal exchange rate has also appreciated twice (in 2007 and

2008) in the 2001-2009 period. This led to lower inflation and growth rates in Gambia in 2009.

Table 1: Number of first order convergence criteria met by WAMZ (2001-2010)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	ΔNER sup +/- 15%	
Gambia	2	1	1	3	3	4	4	4	3	2	2	1
Ghana	1	0	2	2	2	2	2	0	2	3	0	3
Guinea	3	2	0	0	2	1	2	1	1	1	0	7
Nigeria	3	3	2	3	3	4	4	3	3	2	0	0
Sierra Leone	2	2	0	2	2	2	2	2	1	1	0	4
Total	11	8	5	10	12	13	14	10	10	9	+	-

Notes:
+ equal to appreciation and – equal to depreciation of the nominal exchange rate (NER) against WAMZ Exchange Rate Mechanism II (ERMII).

Source: West African Monetary Institution (WAMI)

1.2. Literature review on ECOWAS

Empirical researches on the viability or feasibility of a monetary union in ECOWAS rely on the seminal work on OCA developed by Mundell (1961) and its extensions. While most of these studies show that a monetary union for ECOWAS area is not optimal since its costs outweigh its potential benefits, some remain optimistic because of the endogeneity of the OCA properties.

A monetary union compromised by heterogeneity

The OCA theory states that the loss of an independent monetary policy would be the main cost for a country when it joins a monetary union.[7] This cost tends to be more important when countries of the monetary union are heterogeneous or are facing significant asymmetric shocks. Indeed, under these conditions, each country needs autonomous monetary and exchange rate policies to make the necessary adjustments. Thus, several studies focus on the heterogeneity and asymmetric shocks between member countries of the ECOWAS area. They conclude, in general, that the costs of the future monetary union will outweigh its benefits.

[7] Although for WAEMU countries, this tool of economic policy no longer exists because of the anchoring to the Euro, they could lost their credibility if they left the guarantee afforded to them by the French Treasury.

Using a dynamic factor model, Houssa (2008) indicates that a monetary union in ECOWAS would be economically costly given the asymmetry of supply shocks between countries. He also highlights positive correlation of demand shocks, but the latter—which have only a temporary impact on output—are less important than supply shocks in monetary union (see Bayoumi and Eichengreen, 1993). Estimating VAR models, Coleman (2004) concludes to the existence of significant correlation between shocks within the CFA area (especially for the exchange rate shocks) contrary to the non-CFA countries. The latter are characterized by less symmetry between them and also with the CFA franc zone. More recently, Chuku (2012) highlights that internal shocks tend to be asymmetric while external ones were rather symmetric. Indeed, he shows that almost 85 percent of correlations in supply, demand and monetary shocks within the ECOWAS are asymmetric, while real exchange rate shocks (external shocks) tend to be symmetric. These studies perfectly illustrate the problem of inconclusiveness of OCA analysis previously quoted.

The issue of heterogeneity between African countries raises the question of the geography of monetary unions that was asked by Masson and Patillo (2004). Indeed, given the asymmetric features of its economies, it is important to study the potentially "suitable" geographical areas for forming monetary unions in Africa. To this end, Bénassy-Quéré and Coupet (2005) use a cluster analysis to provide an assessment of the economic adequacy of CAEMC, WAEMU, WAMZ and ECOWAS as the boundaries of monetary area(s). According to these authors, the CFA area is not an optimal currency area even if a "core" of the WAEMU can be defined on economic criteria. They also state that the ECOWAS monetary union (union around Nigeria) is not economically viable. However, Ghana, Gambia and Sierra Leone could connect to the 'core' of the WAEMU to create their common currency. In the same vein, Tsangarides and Qureshi (2008) use the cluster analysis on a set of variables related to the OCA theory and convergence criteria. They show that WAEMU and WAMZ areas countries do not form a homogeneous group and also highlight significant heterogeneities between CAEMC and WAEMU as Bénassy-Quéré and Coupet (2005). However, they stress interesting similarities between the CAEMC and WAMZ countries.

Bangaké (2008) studies the relationship between the variability of bilateral exchange rates and relevant variables related to the OCA criteria and finds similar results to those of Bénassy-Quéré and Coupet (2005). He also indicates the existence of a 'core' of the WAEMU to which the Ghana could possibly be added. In addition, he states that an extension of the WAEMU to Nigeria is not desirable as well as the inclusion of Nigeria in the WAMZ.

Other studies based on macroeconomic models seek to analyze the relevance of the ECOWAS monetary union. Debrun et al. (2005) have developed a multinational model in which governments' overspending could affect monetary policy. They use this hypothesis to assess the sustainability of a monetary union in West Africa. Their results show that a monetary union with Nigeria would not be beneficial for the other ECOWAS countries unless it is accompanied by an effective fiscal discipline of Nigeria. The WAEMU countries would have a comparative advantage to stay in the CFA zone rather than forming a monetary union with Nigeria. However, such monetary union would be more desirable for countries not belonging to WAEMU.

Unlike his previous papers, Masson (2006, 2008) considers the endogeneity phenomenon in his cost-benefit analysis of a monetary union in West Africa. He supposes that monetary union would have significant effects on trade within the area. However, his conclusions do not differ far from his previous studies. Indeed, he finds that ECOWAS countries—except Nigeria and to a lesser extent Ghana—would have a net welfare loss following the establishment of the common currency even if the latter leads to double the trade volume. These findings are mainly due to asymmetric shocks of terms of trade but also to differences in terms of fiscal discipline reputation.

Monetary union viable owing to endogeneity criteria

Since the seminal papers of Frankel and Rose (1996, 1997), it is well known that the monetary union can strengthen economic similarity of its member countries through more trade (lower transaction costs), and business cycle synchronization and improvement of policy credibility (multilateral surveillance).[8] These authors show that as countries with closer trade links tend to have more correlated business cycles, monetary unions would be more suitable *ex post* than *ex ante*. Afterward, Rose (2000) uses a gravity model to highlight the significant effect of currency union on trade which is higher than the effect of exchange rate volatility reduction. Consequently, he concludes that countries in monetary union trade more than others, even compared to countries in fixed exchange rate regime. In addition, Frankel and Rose (2002) show that monetary union also leads to higher welfare (increase of income per capita) through trade increase. In the field of policy credibility, authors such as De Grauwe

[8] This position which was those of the European Commission in 1990 was earlier argued by Gros and Thygesen (1990). Another point of view is defended by some authors, such as Krugman (1991) for which high integration can lead member states of an area to more specialization and therefore a reduction of business cycle synchronization between them.

(1996) argue that when a country—especially high inflation country—joins a monetary union, its monetary policy will benefit from credibility gains (see also Alesina et al., 2002). For African economies, Guillaume and Stasavage (2000) state that they can resort to monetary unions to fill the weakness of their institutions which do not allow them to establish credible and sound macroeconomic policies.

Rose's methodology has been used in large literature trying to highlight the phenomenon of endogeneity inherent in monetary unions. Concerning African countries, Carrière (2004) and Qureshi and Tsangarides (2012) use this method to study the effect of the monetary union on trade in the African continent. These authors find significant effects of common currency on the bilateral trade as Rose (2000). However, Qureshi and Tsangarides (2012) show also that the effects of common currency on trade are not significantly different to those of hard peg. This result leads to one question: can African countries opt to hard peg rather than monetary union to achieve their goals in terms of economic integration and development? The Rose's effect was also emphasized by Diop (2007) for ECOWAS countries, showing that the effect of monetary union in this area has the same magnitude as that found by Rose (2000).[9]

Although not numerous, other recent studies are more optimistic about the viability of a monetary union in ECOWAS. According to Debrun et al. (2010) for instance, all ECOWAS countries, especially those belonging to the WAMZ, would have a net welfare gain in forming a common currency except the Gambia. This result is mainly due to the positive externalities associated to the monetary union itself, such as increase in trade, cycle synchronization, and development of mechanisms for stabilization or risk sharing. Tapsoba (2009) emphasizes that papers on heterogeneity of shocks are static and do not incorporate the effects induced by monetary union. He states that a monetary union in the ECOWAS should be beneficial for the countries of the area through more trade integration and higher symmetry of shocks. This author suggests to ECOWAS countries to develop a regional credit market which facilitates the risk-sharing strategies since, for him, saving would be a tool to adjust to shocks and to allow the sharing of heterogeneous risks. Analyzing the variability of real exchange rates' shocks, Ogunkola (2005) is also optimist about the sustainability of a monetary zone in ECOWAS. Referring to Von Hagen and Neumann (1994) and using monthly and quarterly data, he shows that the variability of real exchange rates' shocks of ECOWAS countries decreases over time. For him, this process has been facilitated by structural adjustment

[9] Note also that Rose's article has been widely commented and criticized in the literature (see for instance Lochard, 2005).

programs. However, he underlines that significant differences remain between CFA and non CFA countries. His conclusions are thus in favor of the establishment of the WAMZ (to a lesser extent of the ECOWAS) monetary union.

2. EMPIRICAL METHODOLOGY

2.1. Determinants of equilibrium exchange rates

Our study covers a panel of 17 Sub-Saharan African[10] countries belonging to CFA and WAMZ areas. In order to determine real equilibrium exchange rates of those economies, we refer to the model proposed by Couharde et al. (2012a) which is inspired from Edwards (1988) and Baffes et al. (1999). Their model provides relevant determinants of the real exchange rates of developing economies[11] which can be summarized as follow:

Productivity differentials (Prod) known as the *Balassa-Samuelson* effect: a positive productivity shock in the tradable good sector relative to the non-tradable good sector leads to a wage increase in the former sector; and thus the moving of the workforce towards this sector.[12] Thus, the real exchange rate appreciates through prices increase in sheltered sectors since their demands exceed their supplies. The impact on the equilibrium real exchange is then expected to be positive.[13]

Net foreign asset position (Nfa): Standard intertemporal macroeconomic models predict that debtor countries will need a more depreciated real exchange rate to generate the trade surpluses necessary to pay their external liabilities (Lee et al., 2008). Similarly, when countries have relatively high net foreign assets, they can "afford" a higher appreciation of their real exchange rate while remaining solvent even if it is likely to generate current account deficits. So, the expected effect is positive.

Terms of trade (Tot): They are measured by the ratio of export prices to import prices. The improvement of the terms of trade leads to an increased production of tradable goods and a reallocation of resources in favor of these sectors. Consequently, the trade balance will be improved through rising exports leading to an appreciation of the equilibrium real exchange

[10] Depending on the data availability, we select thirteen countries of CFA area and four WAMZ area countries (see detail in table B in appendix). Given the small time dimension in several developing countries, panel data analysis is more relevant than time series analysis. Chudik and Mongardini (2007) apply both methods on a set of 36 Sub-Saharan Africa countries; they show that the panel method is more robust and leads to better results. The advantages of the using of panel data framework are summarized by Lopez-Villavicencio (2006).

[11] These variables are frequently used in the literature (see among others Toulaboe, 2002; Abdih and Tsangarides, 2006; Roudet et al., 2007; Gnimassoun, 2012).

[12] Under the assumptions of internal mobility of production factors (labor), equal pay between the two sectors and equality between the real wage and productivity (perfect competition).

[13] The exchange rate is defined such as an increase corresponds to its appreciation.

rate. At the same time, this process may be accompanied by a substitution between local products—which become more expensive—and imported products, leading therefore to a depreciation of the real exchange rate. Consequently, the impact of the terms-of-trade variable is undefined and depends on the income and substitution effects' magnitude. However, empirical works generally suggest that the income effect dominates the substitution one (see Dufrénot and Yehoue, 2005).

Openness (Open): This variable is a proxy of studied countries' trade policies. The reduction of tariff increases the level of trade and vice versa. The response of the real equilibrium exchange rate depends on the impact of openness on the current account. If the current account deteriorates, the real equilibrium exchange rate should depreciate to restore external equilibrium. On the contrary, the equilibrium exchange rate will appreciate when the reduction of tariff leads to an improvement of the current account. Consequently, the expected effect is ambiguous, but the empirical literature generally found a negative impact (see Dufrénot and Yehoue, 2005; Mongardini and Rayner, 2009).

Government spending (Gov): The effects of public expenditures depend on their composition. If they are mainly composed by tradable goods, their increase will lead to the depreciation of the real equilibrium exchange rate. However, it is usually assumed that government spending in developing countries is mainly composed by non-tradable goods. In this case, the increase of public spending leads to a rise in internal prices, which generates the appreciation of the real equilibrium exchange rate. The impact of this variable on the real equilibrium exchange rate must then be positive.

Thus, the relationship between the real effective exchange rate (*Reer*) and its fundamentals is written as follows:

$$Reer_{it} = \alpha_i + \beta_1 Prod_{it} + \beta_2 Nfa_{it} + \beta_3 Tot_{it} + \beta_4 Open_{it} + \beta_5 Gov_{it} + \varepsilon_{it} \qquad (1)$$

With *i = 1 to 17* and *t = 1985 to 2009*. All variables are in logarithm, except the net foreign position which is expressed a percentage of GDP. All data sources are given in table B in appendix. For estimating such a relationship, we need preliminary econometric investigations which are detailed in the next section.

2.2. Panel unit root and cointegration tests

Before estimating Equation (1), we have to determine the order of integration of each variable and then to test the existence of a cointegrating relationship between the REER and its

fundamentals. To this end, we rely on recent panel unit root and cointegration tests. To test the unit root hypothesis, we use the third generation unit root test developed by Carrion et al. (2005). This test overcomes deficiencies of previous unit root tests[14] by taking into account both cross-section dependencies and structural breaks in the series. Indeed, the omission of structural breaks in the series can lead to erroneous conclusions as evidenced by Perron (1989) in his seminal paper. In addition, cross-section dependencies are likely to occur in panel data framework, especially for macroeconomic variables as exchange rates. Not accounting for these cross-section correlations can lead to important size distortions (see Pesaran, 2004). If all series under consideration are found to be integrated, we then test for the existence of a long-run relationship between the REER and its determinants using the error correction model based cointegration tests of Westerlund (2007). Compared to the well known cointegration tests of Pedroni (1999, 2004), Westerlund (2007) tests are large enough to allow accounting for dependencies between countries. In addition, Westerlund (2007) developed these tests in order to propose an alternative to residual-based cointegration tests which failed to reject, in many studies, the no-cointegration hypothesis even in the cases where cointegration is strongly suggested by the theory as in the BEER approach.

Unit root tests

Carrion et al. (2005) test is a generalization of the univariate KPSS test usually computed in time series—and of the Hadri (2000) panel unit root test—for the case of multiple structural breaks. The test allows for the presence of multiple breaks—the number of breaks is unknown—under the null hypothesis of stationarity and does not impose the independence of cross sections in the error terms through bootstrapping.[15] Our findings displayed in table 2 show that all variables are integrated, except the degree of openness which appears to be stationary. Consequently, we do not consider the degree of openness in the cointegration relationship.

Table 2: Unit root tests

Models	*Reer*	*Prod*	*Nfa*	*Tot*	*Dep*	*Open*
With constant	5.715***	5.614***	4.254***	9.226***	7.689***	1.063
With constant and trend	21.736***	11.271***	18.845***	12.059***	8.140***	6.233***

*Notes: ***, **, * indicate the rejection of the null hypothesis of stationarity at the 1%, 5% and 10% significance level respectively.*
We allow at maximum two breaks. The optimum break point is chosen by considering the modified Schwarz

[14] For details about previous unit root tests, see for instance Banerjee (1999) and Hurlin and Mignon (2007).
[15] See Couharde et al. (2012b) for an application of this test.

information criterion (LWZ).
The homogeneous long-run variance case is retained for assessing the statistics.

Cointegration tests

We test the long-run relationship between the REER and its integrated fundamentals by using error-correction-based panel cointegration tests of Westerlund (2007), which can be described as follows:

$$Reer_{it} = \delta_i' d_t + \alpha_i Reer_{i,t-1} + \lambda_i' x_{i,t-1} + \sum_{j=1}^{pi} \alpha_{ij} \Delta Reer_{i,t-j} + \sum_{j=-qi}^{pi} \gamma_{ij} \Delta x_{i,t-j} + e_{it} \quad (2)$$

Where d_t corresponds to the deterministic components (constant and/or trend), Δ is the first difference operator, pi the number of lags, qi the number of leads and x_i denotes the fundamentals. e_{it} is the error term which is independent and identically distributed.

α_i is the error correction coefficient and λ_i' is the product between $(-\alpha_i)$ and long-run value of coefficients of fundamentals ($x_{i,t-1}$). If α_i is significantly lower than 0, then there is error correction implying that *Reer* and its fundamentals are cointegrated. Thus, the null hypothesis of no cointegration is tested by posing $H_0 : \alpha_i = 0$ for all i. The alternative hypothesis depends on α_i which can be homogeneous ($H_a^p : \alpha_i = \alpha < 0$, p for pooling) or heterogeneous ($H_a^g : \alpha_i < 0$ for at least one i, g for grouping). Consequently, Westerlund (2007) provides four test statistics: two assuming heterogeneous cointegration vector (G_t *and* G_a) and two others that suppose homogeneous cointegration vector (P_t *and* P_a). These statistics are summarized in the table 3 below. They strongly reject the null hypothesis of no cointegration between the real effective exchange rate and its macroeconomic fundamentals.

Table 3: Cointegration tests

Statistics	*With constant*			*With constant and trend*		
	Value	Z-Value	P-Value	Value	Z-Value	P-Value
G_t	-2.984	-2.327	0.040	-3.061	-0.897	0.060
G_a	-9.929	1.629	0.020	-10.987	3.042	0.020
P_t	-12.903	-3.734	0.020	-13.170	-2.338	0.000
P_a	-10.783	-0.803	0.040	-11.900	0.952	0.000

Notes: given the relatively small number of observations, we not exceed one (1) for the optimal lag and lead lengths for each series. The Bartlett kernel window width is set according to $4(T/100)^{2/9} \approx 3$. *Only*

bootstrap P-Values are reported.

2.3. Estimation results and interpretation

In order to estimate Equation (1), we use three recent panel cointegration techniques (PMG, DOLS and FMOLS estimators) which allow us to provide consistent estimations of the coefficients. The Pooling Mean Group (PMG) estimator, proposed by Pesaran et al. (1997, 1998), is an intermediate estimator which allows the short-run coefficients and error variances to differ across countries while the long-run coefficients are constrained to be the same for all countries. The Dynamic OLS (DOLS), developed by Kao and Chiang (2000) and Mark and Sul (2003) in the panel data framework, consist in including advanced and delayed values of the explanatory variables in the cointegration relationship in order to eliminate inference problems of standard panel estimators. Indeed, although the OLS estimator of the cointegrating vector is super-convergent, the distribution of coefficients is asymptotically biased and depends on nuisance parameters associated with the presence of unit roots. In this study, we apply the DOLS approach proposed by Mark and Sul (2003) which has the same property as PMG since it constraints the long-run coefficients to be identical for all countries and allows short-run dynamics to differ freely across countries.[16] Finally, we use the Fully Modified OLS (FMOLS) which is developed by Pedroni (2000, 2001). As the DOLS approach, the FMOLS estimator corrects the standard pooled OLS estimator for serial correlation and endogeneity of regressors caused by the presence of unit roots. In the panel setting, the FMOLS long-run coefficients are obtained by averaging the N individual estimated coefficients.[17] Table 4 sums up the estimation results.

Table 4: Estimation results

Variables	Estimation methods					
	PMG		DOLS		FMOLS	
	Coef.	z	Coef.	t-stat.	Coef.	t-stat.
Prod	0.349***	6.01	0.221**	2.45	0.317***	6.46
Nfa	0.070*	1.84	0.221***	2.97	0.385***	14.12
Tot	0.149***	3.26	0.167***	2.25	0.032**	1.75
Gov	0.313***	6.84	0.380***	6.62	0.197***	10.81

*Note: ***, **, * indicate that the variable is respectively significant at 1%, 5% and 10%.*

[16] According to several papers, this assumption seems to be more pertinent in the context of equilibrium exchange rate studies (see Lopez-Villavicencio, 2006).

[17] For more details on these methods, see the quoted papers as well as Bangaké and Eggoh (2011) for a brief review.

All considered explanatory variables are significant at conventional levels for all estimation methods. Fundamentals have also the expected sign highlighting the relevance of the theoretical model and the estimators. Our results confirm the presence of a Balassa-Samuelson effect in the countries under review, since the elasticities associated to productivity are positive and significant. As predicted in theoretical standard inter-temporal macroeconomic models, the net foreign asset position has a positive and significant effect on the real equilibrium exchange rate. The positive relationship between the terms of trade and real effective exchange rate indicates that the income effect outweighs the substitution effect. The government spending has also a positive effect on the real equilibrium exchange rate confirming that in these countries, government spending is mainly composed by non-tradable goods. Moreover, the size of the coefficients is in line with previous empirical studies on African and developing countries. Indeed, Chudik and Mongardini (2007) use the same estimators for 19 low-income and non-oil countries over the period 1980-2004 and find elasticities in the range of 0.13 to 0.26 for terms of trade, 0.35 to 0.98 for relative productivity and 0.11 to 0.53 for public spending. Dufrénot and Yehoue (2005) use similar dynamic panel estimators for 28 low-income and their estimated elasticities are in the range of 0.05 to 0.27 for terms of trade, 0.12 to 0.34 for productivity and respectively 0.17 and 0.10 for net foreign assets and government consumption. More recently, Elbadawi et al. (2009) use the PMG estimator and find elasticities of around 0.21 and 2.62 respectively for terms of trade and government consumption, 0.31 to 0.56 for productivity and 0.01 to 0.07 for net foreign income.

3. DYNAMICS OF REAL EXCHANGE RATE MISALIGNMENTS

We use the coefficients displayed in table 4 to assess real equilibrium exchange rates. We then deduce misalignments as the difference between the observed real exchange rates and their equilibrium values. As three methods have been used to estimate the equilibrium exchange rate, three different misalignment series will be derived for each country. We use the methodology developed by Elbadawi et al. (2008)[18] to assess the misalignments for all estimators and all countries. The latter are represented in Figure A2 in appendix. Afterwards, we apply a simple mean of countries' misalignments to obtain a unique and robust estimation. This allows us to control the uncertainty related to coefficients.

[18] As shown by the authors, this methodology is more relevant in a panel data framework.

3.1. Similarities and difference in exchange rate misalignments' behaviours

Regional misalignments

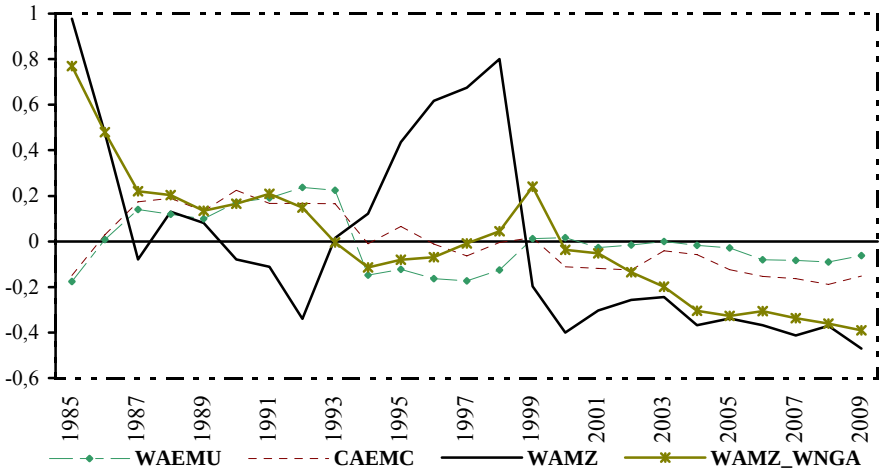
We consider the misalignments of four different areas: WAEMU, CAEMC, WAMZ and WAMZ without Nigeria (noted hereafter, WAMZ_WNGA). The regional misalignments are calculated as the weighted averages of misalignments of states belonging to the area. The weights used correspond to the share of each country in the considered area's real GDP (see table B in appendix).

Figure 1 below shows the evolution of regional misalignments. While displaying slightly differences in levels, the misalignment of the overall WAEMU has almost the same evolution as that of the CAEMC area. Indeed, from 1986 to 1993 exchange rates were overvalued, while undervaluation characterized the 2001-2009 period. Between these two periods, they slightly differ. While the features of their economies are different, the relatively close WAEMU and CAEMC misalignments highlight the influence of their common anchor currency (see Gnimassoun, 2012). Compared to the CFA zone monetary unions, the misalignment within the WAMZ area is significantly larger. It is also out of phase with that of the CFA area, until 1999, particularly during the 1994-1999 period. Indeed, over this period, the CFA zone countries are characterized by undervalued real exchange rates partly due to the effects of the CFA franc devaluation of 1994 while real exchange rates in the WAMZ area exhibits a strong overvaluation. However, since early 2000, the misalignment of all areas is negative although significant differences in levels remain. This synchronization of misalignments' cycles has two main explanations. On the one hand, it can be explained by internal factors related to the convergence criteria such as more stable exchange rate and more suitable economic policies. On the other hand, undervalued real exchange rates of these areas member states could come from the significant improvement of their terms of trade in 2000s through increasing commodity prices and also from better net foreign asset positions in recent years (see figure A1 in appendix). Indeed, the improvement of the terms of trade or of the net foreign asset position leads to higher equilibrium exchange rate, and increases therefore the probability of having an undervalued exchange rate.

Since WAMZ area misalignment is significantly dominated by that of the Nigeria, which products almost 90% of the area's real GDP, we also consider the WAMZ region without this country. This reveals some interesting similarities between the CFA zone monetary unions

and the other countries of the WAMZ area. Indeed, the cycles of the misalignments of the WAEMU and the CAEMC are slightly close with those of other states of the WAMZ area. These findings corroborate results usually found in the literature on the heterogeneity of West African countries (see section 1.2). It also confirms the approximation between misalignment of the WAMZ and those of the CFA zone monetary unions, since 2000.

Figure 1: Evolution of regional misalignments



A positive (resp. negative) value corresponds to an overvaluation (resp. undervaluation).

In order to strengthen our analysis, we also study the correlation between regional misalignments (table 5). Over the 1985-2009 period, two important facts can be highlighted. On the one hand, the significant negative relationship between WAEMU and WAMZ misalignments indicates large differences between the WAEMU countries and Nigeria in terms of competitiveness. In contrast, the WAMZ is positively linked to the CAEMC area. On the other hand, table 5 highlights the proximity between the other WAMZ countries and the CFA area monetary unions, since the former area's misalignment is positively correlated to those of the CAEMC and the WAEMU areas. However, considering the recent period (2001-2009), our results show a high positive correlation between the four areas' misalignments, particularly between those of the WAMZ and the WAEMU. In conclusion, heterogeneities between areas have been considerably reduced in the 2000s, partly due to the improvement of the economic environment in most countries and the convergence of macroeconomic fundamentals (see figure A1 in appendix).

Table 5: Regional misalignments correlations

Periods	1985-2009				2001-2009			
AREAS	CAEMC	WAEMU	WAMZ	WAMZ_ WNGA	CAEMC	WAEMU	WAMZ	WAMZ_ WNGA
CAEMC	1.00				1.00			
WAEMU	0.75a	1.00			0.88a	1.00		
WAMZ	0.16	-0.40b	1.00		0.55d	0.71b	1.00	
WAMZ_WNGA	0.47b	0.24	0.60a	1.00	0.40	0.61c	0.78b	1.00

Note: a, b, c and d indicate that correlations are significant at respectively 1%, 5%, 10% and 15%.

Intra-regional misalignments

The analyses above by focusing on synchronization on regional misalignments only presents the major drawback that insufficient concern is taken in analyzing the likely heterogeneity between countries belonging to the same area. In order to overcome this drawback, we analyze, in this section, the synchronization of misalignments within the different areas using correlation matrixes of misalignments (reported in table A, in appendix). These correlation matrixes are summarized in the table 6 below. In the WAEMU, more than half (57%) of competitiveness shocks are positively correlated, while only 14% of them are negatively correlated. Among these shocks' correlations, 38% are greater than 0.5, while 29% are greater than 0.75 indicating relative high symmetry between WAEMU countries' competitiveness shocks. This result illustrates the homogeneity in terms of economic competitiveness of some WAEMU countries, namely Burkina Faso, Mali, Niger and Senegal whose bilateral correlations of misalignments are above 70%. These four countries constitute however the core of the WAEMU (see section 3.4). Benin also appears to be closely linked to Côte d'Ivoire, unlike Togo which is negatively correlated to other WAEMU members. Regarding the CAEMC area, 47% of competitiveness shocks of its member states are positively correlated and almost 20% are negatively correlated. This heterogeneity of the CAEMC area mainly comes from the Central African Republic which is less aligned with the other member countries. Note that the Central African Republic is the only non-oil exporter of the CAEMC explaining its difference with the other countries of this area. The share of high positive correlation is low in CAEMC compared to WAEMU, suggesting that the later area is more optimal than the former one. Surprisingly, 100% of competitiveness shocks within WAMZ are positively correlated, with 68% of them higher than 0.50 (but lower than 0.75) and there is no negative correlation of misalignments. This can be related to the fact that WAMZ countries frequently use their exchange rates to respond to economic shocks as previously argued in section 1.1 (see table 1).

The features of the misalignments' correlations within ECOWAS are similar to those of the CAEMC. Apart from accounting the correlations of misalignments within WAEMU area, this result is due to large correlations between Ghana and, to a lesser extent, Sierra Leone and WAEMU member states indicating that these two countries could join the WAEMU to share a common currency without much difficulty. Cross regional correlations of misalignments, defined as correlation between countries (i) and (j) belonging to two different areas, confirm this analysis. They also show that Mali and Burkina Faso are closest to the member countries of WAMZ area. In contrast, Togo, Benin, Côte d'Ivoire and Nigeria are negatively correlated to the countries of the other area. Thus, they will be less comfortable than other countries in the future monetary union of ECOWAS. Compared to the CAEMC-WAMZ union, the ECOWAS has more negative correlations and is thus less optimal. Indeed, Nigeria and Gambia seem more closed to the CAEMC than the WAEMU area.

Table 6: Summary of intra-regional misalignments correlations

Significant Correlation Coefficients	Intra regional correlations						Cross regional correlations		
	WAEMU	CAEMC	WAMZ	CFA	ECOWAS	CAEMC-WAMZ	CAEMC-WAEMU	WAEMU-WAMZ	CEMAC-WAMZ
positive	57.1%	46.7%	100.0%	53.8%	47.3%	51.1%	54.8%	32.1%	37.5%
>/= 0.50	38.1%	33.3%	66.7%	34.6%	30.9%	26.7%	31.0%	14.3%	8.3%
>/= 0.75	28.6%	13.3%	0.0%	14.10%	14.6%	4.4%	11.9%	10.7%	0.0%
negative	14.3%	20.0%	0.0%	10.3%	20.0%	13.3%	4.8%	32.1%	12.5%

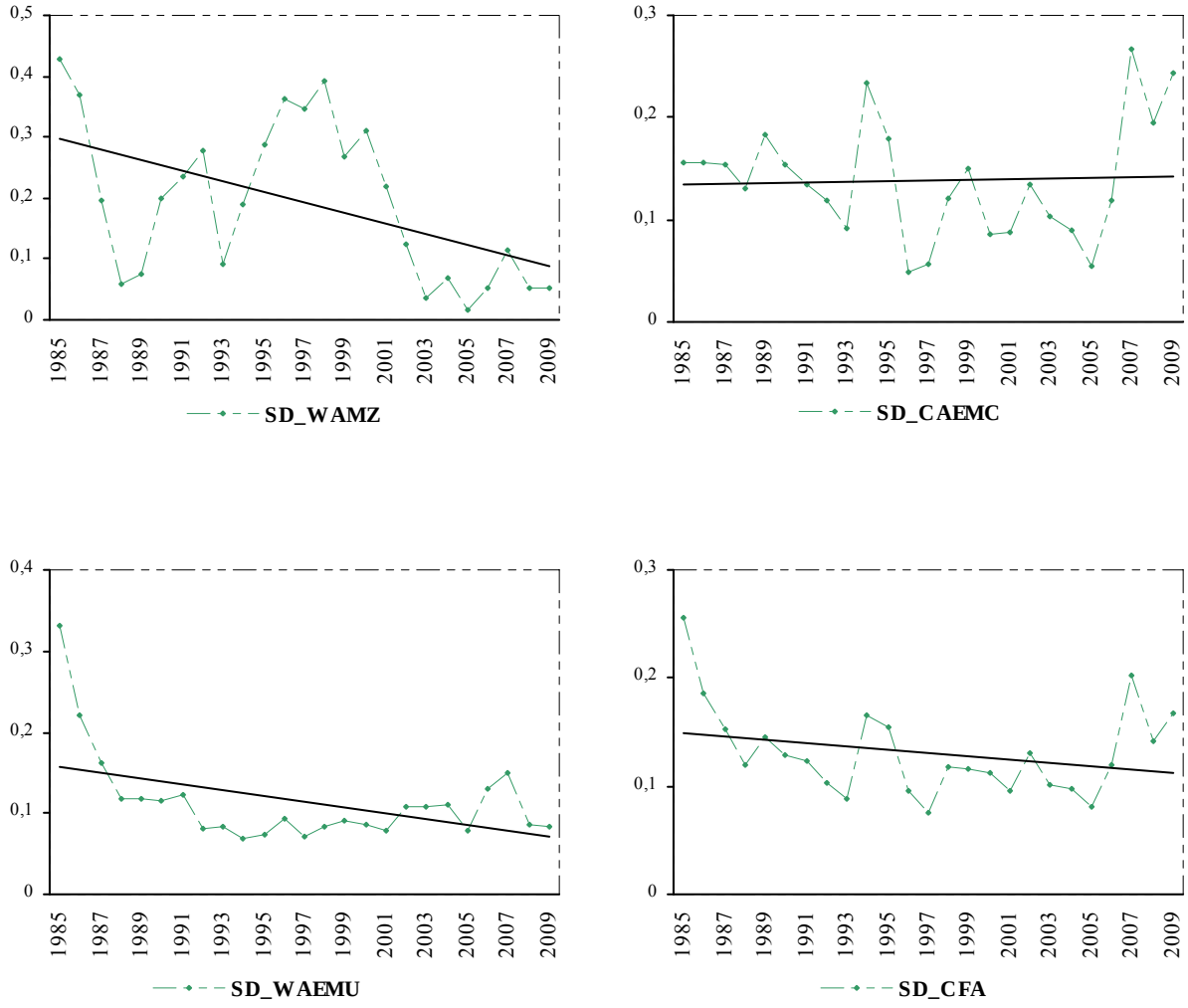
Source: Authors' calculations

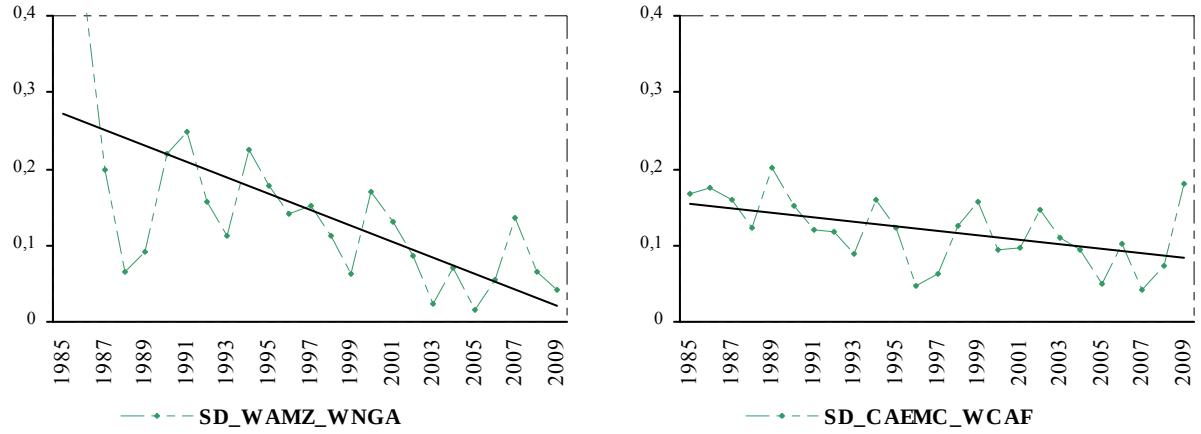
In sum, the analysis of misalignments shows that CFA zone monetary unions have the same phases of misalignments despite their heterogeneity. It also highlights a relative compatibility between WAEMU and the WAMZ area without Nigeria which is more close to the CAEMC zone. However, a significant convergence has been achieved between area' competitiveness since the establishment of convergence criteria in 2001. Finally, regarding competitiveness evolutions, cross regional correlations of misalignments highlight interesting similarities of Ghana and Sierra Leone with the WAEMU area, and Nigeria and Gambia with the CAEMC countries.

3.2. Convergence of exchange rate misalignments

In order to strengthen our previous results regarding heterogeneity of the monetary unions, we assess the dispersion of misalignments and study their sigma-convergence within considered areas by analyzing the evolution of their standard errors.

Figure 2: Evolution of the standard deviations (SD) of areas' misalignments





As shown in figure 2, the dispersion of misalignments within the WAMZ area exhibits a remarkable downward trend and converges toward 10%, level at which the WAEMU's dispersion has stabilized since the 1994 devaluation. Particularly, since 2000, dispersion of misalignments in the WAMZ area has relatively diminished reflecting a convergence between competitiveness levels of its member states. This convergence is more remarkable if we do not take into account Nigeria. With a low and stable dispersion of misalignments, the WAEMU area seems to be the most optimal area in West Africa. In contrast, the CAEMC area displays a lack of convergence since it exhibits larger dispersion of exchange rate misalignments than other areas. However, this is largely due to the Central African Republic which does not seem to be compatible with other countries of the area. Without the latter country, the CAEMC countries also display a relatively stable dispersion of misalignments, even if it remains higher than those of WAEMU and WAMZ.

3.3. Delimiting the borders of the ECOWAS area: a cluster analysis

As Bénassy-Quéré and Coupet (2005) and Tsangarides and Queshi (2008), we implement a cluster analysis to study similarities and dissimilarities between West African countries in terms of economic competitiveness. However, while these authors use several variables related to the OCA criteria to study the homogeneity of West African, we focus here only on exchange rate misalignments as a global indicator of optimality of a monetary area.

In practice, the cluster analysis is carried out in four steps. The first one consists in defining the number of variables (features, P) for N objects to study. In our case, N corresponds to the number of countries (N=17) and P corresponds to five years average of countries' misalignments from 1985 to 2009 (P=5).[19] In the second step, we choose the dissimilarity coefficient or distance, $d(j,k)$, between two objects (x_j and x_k). For measuring the distance, several methods are proposed in the literature, the most used being the Euclidean distance (or Euclidean distance squared). In this study we use the latter described as follow for p variables ($x_1,.....,x_p$):

$$d(j,k) = \sqrt{\sum_{i=1}^{p} (x_{ji} - x_{ki})^2} \tag{3}$$

The third step consists in choosing the dissimilarity coefficient between two clusters. This choice determines the shape of the homogeneous groups. Among agglomerative methods proposed in the literature[20], Ward's method is the most used. This method is a general hierarchical clustering approach where groups are joined to maximize an objective function. More specifically, it consists to join two groups that result in the minimum increase in the error sum of squares. In addition to Ward's method, we use two alternative approaches (single-linkage and centroid-linkage methods) to check the robustness of our results. Single-linkage clustering computes the similarity or dissimilarity between two groups as the similarity or dissimilarity between the closest pair of observations between the two groups. Concerning the centroid method, the distance between two clusters is calculated as the sum of distances between cluster means for all of the variables. The three approaches used in this study can be described by the following recurrence formula developed by Lance and Williams (1967):

$$d_{k(ij)} = \alpha_i d_{ki} + \alpha_j d_{kj} + \beta d_{ij} + \gamma \left| d_{ki} - d_{kj} \right| \tag{4}$$

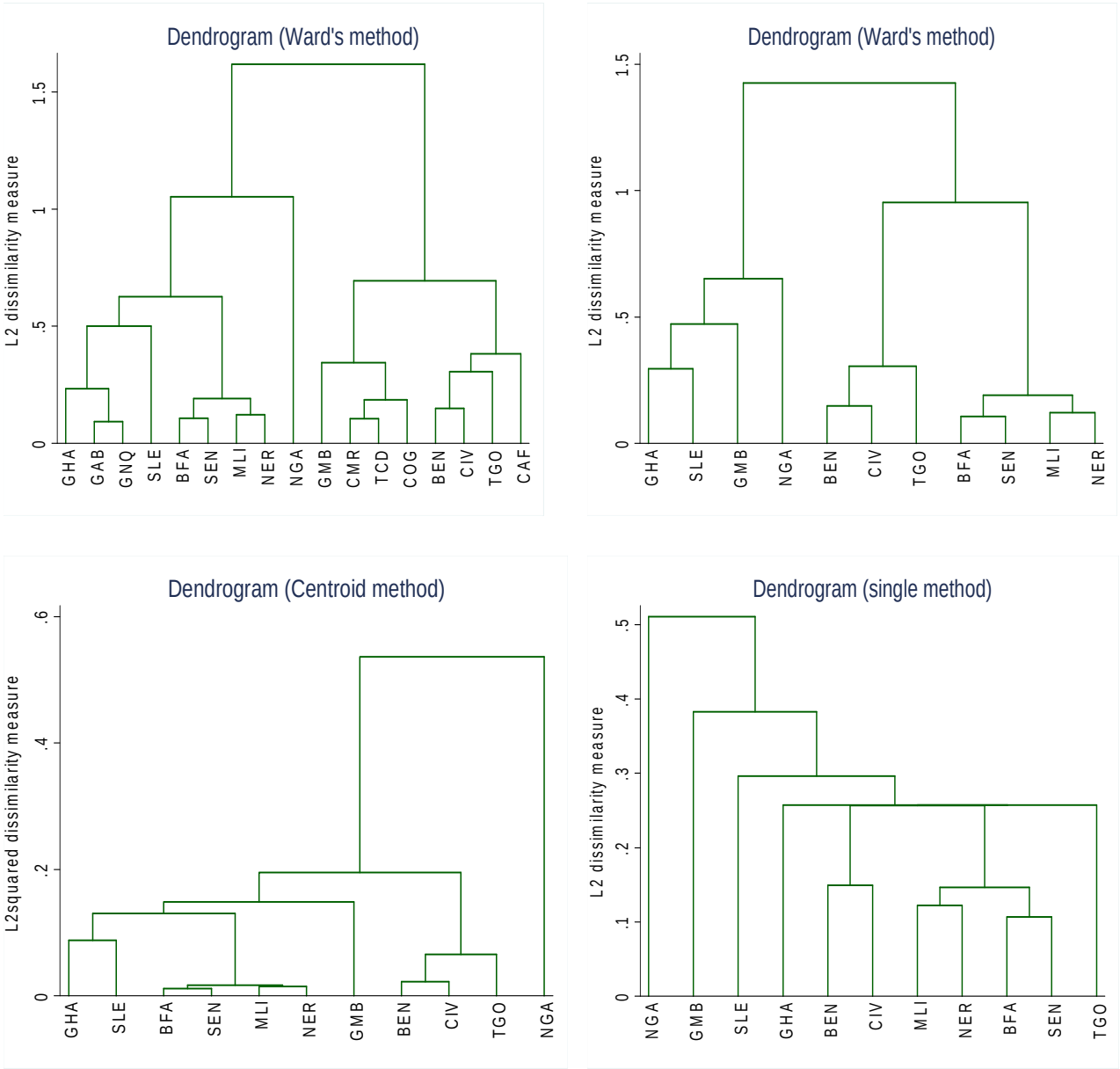
where d_{ij} is the distance between a cluster i and j; $d_{k(ij)}$ is the distance between a cluster k and another cluster formed by i and j. The parameters ($\alpha_i, \alpha_j, \beta$ and γ), whose values are summarized in table C in appendix, depend on the used cluster-analysis method.

[19] The choice of P does not significantly influence our findings. Results for other values of P are available upon request from authors.

[20] For more details on these methods, see Kaufman and Rousseeuw (1990).

Finally, results are presented as dendrograms indicating the order in which successive aggregations were made. Figure 4 below represents the dendrograms for the three different methods.

Figure 4: Dendrograms for different methods



The first graph represents the dendrogram of the all 17 countries of our sample using Ward's method. It identifies a core for the WAEMU area that is composed by Burkina Faso, Mali, Niger and Senegal. This core can be joined by Ghana and Sierra Leone from the WAMZ area and Equatorial Guinea and Gabon from the CAEMC area. The remaining countries form other

homogeneous groups from distinct areas. Benin, Côte d'Ivoire and Togo have a similarity with the Central African Republic, while Gambia is near to the group formed by Cameroon, Congo and Chad. Regarding the dissimilarities, Nigeria appears to be a singleton in West Africa.

In order to analyze the formation of the future monetary union of ECOWAS, the other three graphs shown here concern only countries of this area. The Ward's method validates the strategy adopted by ECOWAS leader which consists to form WAMZ monetary union which will merge with the WAEMU. According to this method, the competitiveness level of WAMZ countries is more homogeneous with the other members of this area than with countries belonging to the WAEMU area. However, heterogeneity remains within these two areas. The results from the Ward's method are different to those obtained with the two other methods. The centroid method corroborates the core of the WAEMU which can be joined by the cluster formed by Ghana and Sierra Leone, and by Gambia, to a lesser extent. This method also highlights the differences between Nigeria and the rest of ECOWAS member states. Concerning single-linkage method, it confirms the proximity between Ghana and the WAEMU countries, and the dissimilarity of the latter with Nigeria. Sierra Leone and Gambia can also join the WAEMU, but with most costs than Ghana. On the whole, these findings corroborate those of Bénassy-Quéré and Coupet (2008) and Tsangarides and Queshi (2008) which use several variables related to the OCA criteria, highlighting the relevance of using the exchange rate misalignments as a global indicator of the optimality of a monetary union.

3.4. Which anchor currency for the ECOWAS area?

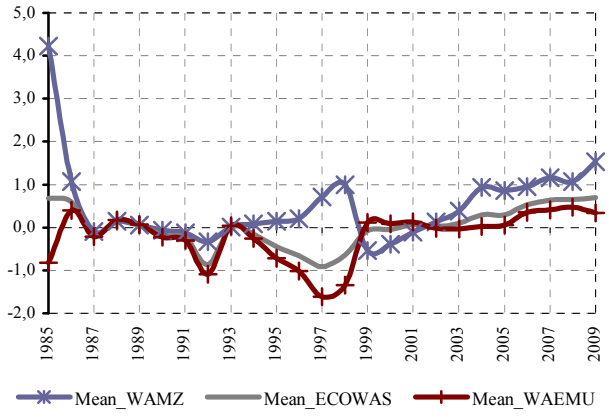
Finally, we seek to determine which currency could act as the best anchor for the ECOWAS area by analyzing co-movements between exchange rate misalignments, in the spirit of the methodology developed by Alesina et al. (2002). In order to analyze the cost and benefit for several countries to adopt as an anchor the dollar, the euro or the yen, those authors study the co-movements of considered countries' prices and output with respectively those of the US, Euro area and Japan. Co-movements are computed as the standard deviation of errors from AR (2) estimations of relative prices and output. Such econometric method, frequently used in the OCA literature, could not be relevant in our study since (i) exchange rate misalignments are estimated, and (ii) the time dimension is quite low (25 years). Accordingly, we use a methodology recently proposed by Yetman (2011) which is a year-by-year decomposition of

the correlation between two countries. As Alesina et al. (2002)' co-movements analysis, this method aims to determine the best anchor for a country and also to identify periods in which countries are more or less correlated to the anchor. The more the co-movements with the chosen reference currency are high, the more the countries will take advantage of pegging their currencies to this reference currency. For the ECOWAS area, since there is no natural leader which applies sound monetary policy, we consider five different references. The first one is Nigeria which is the first economy of the area but has higher inflation rate and public deficit than WAEMU countries. Given that the monetary unions of the CFA zone are known for their economic stability compared to other SSA countries, we consider them as second and third plausible references for the area. As mentioned by Guillaume and Stasavage (2000), it is the weakness of institutions that prevents these countries to implement sound economic policies. Thus, we chose two countries (Ghana and Senegal) which are known for the stability of their institutions compared to other countries of the ECOWAS area. In addition, these two countries are respectively the second economy of the WAMZ and the WAEMU areas.

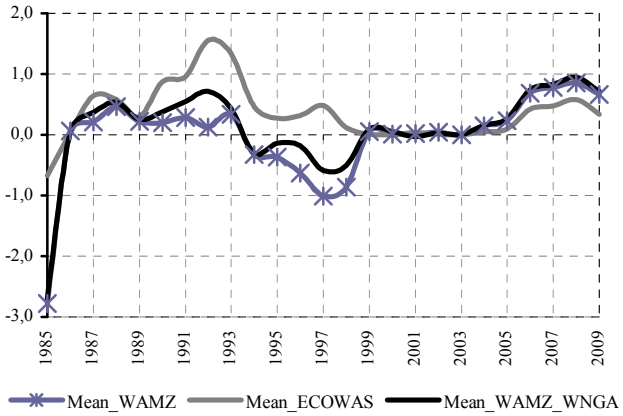
Figure 3 below reports the evolution of co-movements with the quoted countries and areas. Co-movements with Nigeria were essentially negative before 2002. After this year, they become positive but remain relatively low. Co-movements with WAEMU were slightly better than those with Nigeria since the overall ECOWAS were positively linked to WAEMU area over the 1986-2009 period. However, WAEMU displayed high negative co-movements with WAMZ countries, especially with Nigeria between 1994 and 2000. In contrast, the CAEMC area and Ghana seem to be the best anchors for WAMZ area members. These two references have few and low negative co-movements with the WAMZ area countries especially in recent years were the co-movements values are near to two. For the whole ECOWAS area, Senegal and Ghana show similar co-movements with the rest of the area members. This last result leads to the conclusion that countries with strong institutions seem to be the best references for all ECOWAS area. On the whole, figure 3 shows that co-movements of exchange rate misalignments have been improved in recent years, whatever the considered reference.

Figure 3: Evolution of co-movements with different references

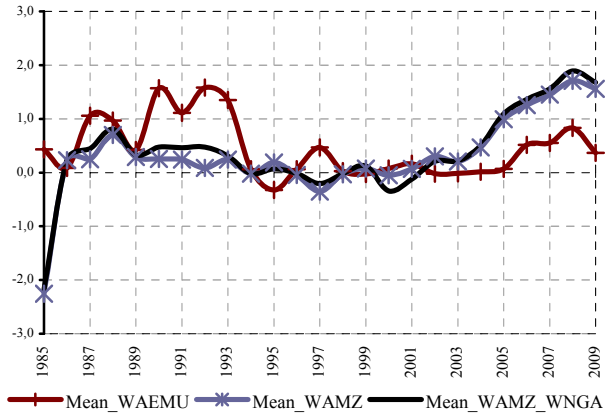
Co-mouvements with Nigeria



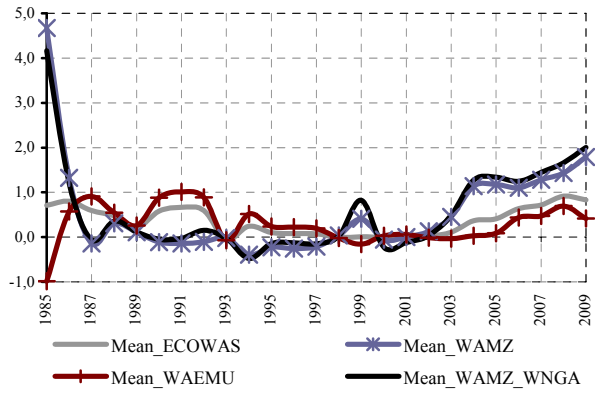
Co-mouvements with WAEMU



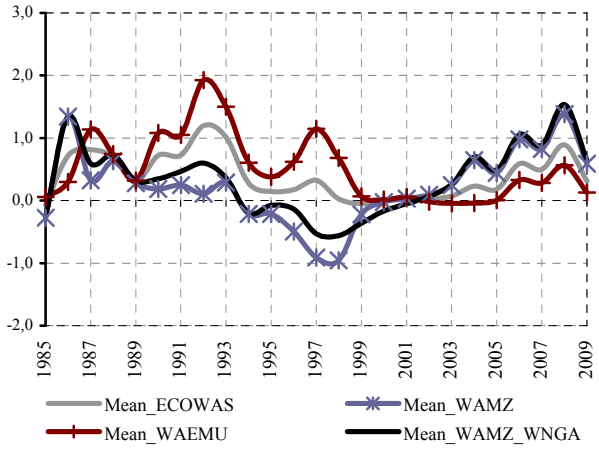
Co-movements with CAEMC



Co-mouvements with Ghana



Co-mouvements with Senegal



CONCLUSION

The aim of this paper was to investigate the optimality of currency union in the Economic Community of West African States (ECOWAS) by paying a particular attention to the economic competitiveness of member countries. Large differences in competitiveness between countries within a monetary union could lead to current imbalances and thus may challenge the stability of the union, as evidenced by the recent experience of the Euro area. With the recent crisis in the Euro area, one could expect that the economic competitiveness will have an important place in the debate on the optimality or not of a monetary union.

As a proxy of competitiveness, we consider exchange rate misalignments, which constitute a useful indicator of the viability of a monetary union. Relying on the behavioral equilibrium exchange rate approach and using recent panel cointegration techniques, we derive currency misalignments for the various monetary unions in West Africa (CAEMC, WAEMU and WAMZ) and analyze their dynamics in terms of sigma-convergence and co-movements. Complemented by a cluster analysis, our findings show that, among these areas, WAEMU is the most homogeneous zone with high correlation between its member countries competitiveness level. This area is characterized by a core composed by Burkina Faso, Mali, Niger and Senegal which could be joined by Ghana, Sierra Leone and, to a lesser extent, by Gambia from the WAMZ area. Our results also evidence a specific group of oil-exporting countries by showing similarities between Nigeria misalignments and those of the CAEMC area, indicating that the former country would have a greater interest in joining the CAEMC area, rather than the WAEMU area. Finally, in the perspective of the creation of the monetary union of ECOWAS, Ghana and Senegal would be the best references for the area. Indeed, in addition to be institutionally stable and economically relatively strong countries, their misalignments are positively correlated to those of most ECOWAS member states.

REFERENCES

Abdih, Y. and C. Tsangarides (2006) "FEER for the CFA franc", IMF Working Paper 06/236, Washington: International Monetary Fund.

Alesina, A., R. J. Barro and S. Tenreyro (2002) "Optimal Currency Areas", NBER Working Paper 5770, National Bureau of Economic Research, Inc.

Baffes, J., I. Elbadawi and S. O'Connell (1999) "Single-Equation Estimation of the Equilibrium Real Exchange Rate" In L. Hinkle and P. Montiel, eds., *Exchange Rate*

Misalignment: Concepts and Measurement for Developing Countries. Washington, D.C.: World Bank.

Banerjee, A. (1999) "Panel Data Unit Roots and Cointegration: An Overview", Oxford Bulletin of Economics and Statistics, vol. 61(0), pp. 607-29.

Bangaké, C. (2008) "Exchange Rate Volatility and Optimum Currency Area: Evidence from Africa", Economics Bulletin, vol. 6(12), pp. 1-10.

Bangaké, C. and J. Eggoh (2011) "The Feldstein-Horioka puzzle in African countries: A panel cointegration analysis", Economic Modelling, vol. 28(3), pp. 939-947.

Bayoumi, T. and B. Eichengreen (1993) "Shocking aspects of European monetary unification", In F. Torres and F. Giavazzi, eds., *Adjustment and growth in the European Monetary Union*. Cambridge University Press, Cambridge.

Bénassy-Quéré, A. and M. Coupet (2005) "On the Adequacy of Monetary Arrangements in Sub-Saharan Africa", The World Economy, vol. 28(3), pp. 349-373.

Carrère, C. (2004) "African regional agreements: impact on trade with or without currency unions", Journal of African Economics, vol. 13(2), pp. 199-239.

Carrion-I, S., T. Del Barrio-Castro and E. Lopez-Bazo (2005) "Breaking the panels: An application to GDP per capita", Econometrics Journal, 8: 159-175.

Chudik, A. and J. Mongardini (2007) "In Search of Equilibrium: Estimating Equilibrium Real Exchange Rates in Low-Income African Countries", IMF Working Paper 07/90, Washington: International Monetary Fund.

Chuku, A. (2012) "The proposed eco: should West Africa proceed with a common currency?", Centre for the Study of African Economies (CSAE); Conference on "Economic Development in Africa" Oxford University, Oxford 18-20 March.

Clark, P. B. and R. MacDonald (1998) "Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs", IMF Working Paper 98/67, Washington: International Monetary Fund.

Coleman, S. (2004) "An Aggregate View of Macroeconomic Shocks in Sub-Saharan Africa: A Comparative Study Using Innovation Accounting", UNU-WIDER Research Paper No. 2004/9.

Coudert, V., C. Couharde and V. Mignon (2012) "On currency misalignments within the Euro area", CEPII Working Paper 2012-07, Centre d'Etudes Prospectives et d'Informations internationales, Paris.

Couharde, C., I. Coulibaly and O. Damette (2012a) "La dynamique d'ajustement des taux de change réels dans la zone franc CFA", Revue économique, vol. 63(3), pp. 545-555.

Couharde, C., I. Coulibaly, D. Guerreiro and V. Mignon (2012b) "Revisiting the theory of optimum currency areas: Is the CFA franc zone sustainable?", CEPII Working Paper 2012-13, Centre d'Etudes Prospectives et d'Informations internationales, Paris.

De Grauwe, P. (1996) "Monetary union and economic convergence", European Economic Review, pp. 1091–1101.

Debrun, X., P. Masson and C. Pattillo (2005) "Monetary union in West Africa: who might gain, who might lose, and why?", Canadian Journal of Economics, vol. 38(2), pp. 454-481.

Debrun, X., P. Masson and C. Pattillo (2010) "Should African Monetary Unions Be Expanded? An Empirical Investigation of the Scope for Monetary Integration in Sub-Saharan Africa", IMF Working Paper 10/157, Washington: International Monetary Fund.

Diop, C. (2007) "L'UEMOA et la perspective d'une zone monétaire unique de la CEDEAO: les enseignements d'un modèle de gravité", Document d'Etude et de Recherche BCEAO, N° DER/07/01 - Avril.

Dufrénot, G. and E. Yehoue (2005) "Real Exchange Rate Misalignment: A Panel Co-Integration and Common Factor Analysis", IMF Working Paper 05/164, Washington: International Monetary Fund.

Edwards, S. (1988) "Real and Monetary Determinants of Real Exchange Rate Behavior: Theory and Evidence from Developing Countries", UCLA Economics Working Papers 506, UCLA Department of Economics.

Elbadawi, I., L. Kaltani and R. Soto (2009) "Aid, Real Exchange Rate Misalignment and Economic Performance in Sub-Saharan Africa", Documentos de Trabajo 368, Instituto de Economia. Pontificia Universidad Católica de Chile.

Fielding, D (2005) "Macroeconomic Policy in the Franc Zone", Palgrave Macmillan, UNU-WIDER: United Nations University-World Institute for Development Economics Research.

Frankel, J. and A. Rose (1996) "The Endogeneity of the Optimum Currency Area Criteria?", NBER Working Paper 5770, National Bureau of Economic Research, Inc.

Frankel, J. and A. Rose (1997) "Is EMU More Justifiable Ex Post than Ex Ante?", European Economic Review, vol. 41(3-5), pp.753-760.

Frankel, J. and A. Rose (2002) "An Estimate of the Effect of Common Currencies on Trade and Income", The Quarterly Journal of Economics, vol. 117(2), pp. 437-466.

Gnimassoun, B. (2012) "Taux de change et mésalignements du franc CFA avant et après l'introduction de l'Euro", EconomiX Working Paper 2012-3, University of Paris Ouest-Nanterre la Défense, Paris.

Gros, D. and N. Thygesen (1990) "Vers l'union monétaire européenne: pourquoi et comment?", Revue de l'OFCE, N°33, pp. 131-153.

Guillaume, D. and D. Stasavage (2000) "Improving Policy Credibility: Is There a Case for African Monetary Unions?", World Development, vol. 28(8), pp. 1391-1407.

Hadri, K. (2000) "Testing for Unit Roots in Heterogeneous Panel Data", Econometrics Journal, vol. (3), pp. 148-161.

Houssa, R. (2008) "Monetary union in West Africa and asymmetric shocks: A dynamic structural factor model approach", Journal of Development Economics, vol. 85(1-2), pp. 319-347.

Hurlin, C. and V. Mignon (2007) "Une synthèse des tests de cointégration sur données de panel", Economie et Prévision, n°180-181, pp. 241-265.

Kao, C. and M. Chiang (2000) "On the estimation and inference of a cointegrated regression in panel data", Econometrics 9703001, EconWPA.

Kaufman, L. and P. J. Rousseeuw (1990) "Finding Groups in Data: An Introduction to Cluster Analysis", New York: Wiley in StataCorp. (ed) *Stata: Release 11.*

Krugman, P. (1991) "Target Zones and Exchange Rate Dynamics", The Quarterly Journal of Economics, Vol. 106(3), pp. 669-682.

Lance, G. N. and W. T. Williams (1967) "A general theory of classificatory sorting strategies: 1. Hierarchical systems", Computer Journal 9: 373–380.

Lee, J., G. Milesi-Ferretti, J. Ostry, A. Prati and L. Ricci (2008) "Exchange Rate Assessments: CGER Methodologies", IMF Occasional Paper No 261, Washington: International Monetary Fund.

Lochard, J. (2005) "Mesurer l'influence des unions monétaires sur le commerce, Economie internationale", International Economics, vol. (103), pp. 5-24.

Lopez-Villavicencio, A. (2006) "Real Equilibrium Exchange rates: A Panel Data Approach for Advanced and Emerging Economies", International Economics, vol. (108), pp. 59-81.

Mark, C. and D. Sul (2003) "Cointegration Vector Estimation by Panel DOLS and Long run Money Demand", Oxford Bulletin of Economics and Statistics, vol. (65), 0305-9049.

Masson, P. and C. Pattillo (2004) "The monetary geography of Africa", Washington, DC: Brookings Institution.

Masson, P. (2006) "New Monetary Unions in Africa: a Major Change in the Monetary Landscape?", International Economics, CEPII research center, issue 3Q, pages 87-105.

Masson, P. (2008) "Currency Unions in Africa: Is the Trade Effect Substantial Enough to Justify their Formation?", The World Economy, vol. 31(4), pp. 533-547.

Mongardini, J. and B. Rayner (2009) "Grants, Remittances, and the Equilibrium Real Exchange Rate in Sub-Saharan African Countries", IMF Working Paper, 09/75, Washington: International Monetary Fund.

Mongelli, F. P. (2008) "European economic and monetary integration and the optimum currency area theory", Economic Papers No 302, European Commission: European Economy, Directorate-General for Economic and Financial Affairs.

Mundell, R. (1961) "A Theory of Optimum Currency Areas", American Economic Review, vol. (51), pp. 509-17.

Ogunkola, O. (2005) "An evaluation of the viability of a single monetary zone in ECOWAS", AERC Research Paper No 147, African Economic Research Consortium.

Pedroni, P. (1999) "Critical values for cointegration tests in heterogeneous panels with multiple regressors", Oxford Bulletin of Economic and Statistics, vol. (61), pp. 653-70.

Pedroni, P. (2000) "Fully Modified OLS for Heterogeneous Cointegrated Panels", Advances in Econometrics, vol. (15), pp. 93-130.

Pedroni, P. (2001) "Purchasing Power Parity Tests in Cointegrated Panels", Review of Economics and Statistics, vol. (83), pp. 727-731.

Pedroni, P. (2004) "Panel cointegration. Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis", Econometric Theory, vol. (20), pp. 597- 625.

Pesaran, M., Y. Shin and R. Smith (1997) "Estimating long-run relationships in dynamic heterogeneous panels", DAE Working Paper Amalgamated Series 9721.

Pesaran, M., Y. Shin and R. Smith (1998) "Pooled Mean Group Estimation of Dynamic Heterogeneous Panel", Journal of the American Statistical Association, vol. 94(446), pp. 621-634.

Qureshi, M. S. and C. Tsangarides (2012) "Hard or Soft Pegs? Choice of Exchange Rate Regime and Trade in Africa", World Development, vol. 40(4), pp. 667-680.

Rose, A. (2000) "One money, One market: Estimating the effect of Common Currencies on Trade", Economic Policy, vol. 15, pp. 7-46.

Roudet, S., M. Saxegaard, and C. Tsangarides (2007) "Estimation of Equilibrium Exchange Rates in the WAEMU: A Robustness Analysis", IMF Working Paper 07/194 Washington: International Monetary Fund.

Tavlas, G. S. (1994) "The Theory of Monetary Integration", Open Economies Review, vol. 5(2), pp. 211-230.

Tapsoba, J. A. (2009) "Union Monétaire en Afrique de l'Ouest: Quelles Réponses à l'Hétérogénéité des Chocs ?", CERDI Working Paper 2009-12, Centre d'Etudes et de Recherches sur le Développement International, France.

Toulaboe, D. (2002) "Real Exchange Rate Misalignment and Economic Growth in Developing Countries", Southwestern Economic Review, vol. 33(1), pp. 57-74.

Tsangarides, C. and M. Qureshi (2008) "Monetary Union Membership in West Africa: A Cluster Analysis", World Development, vol. 36(7), pp. 1261-1279.

Von Hagen, J. and M. Neumann (1994) "Real exchange rates within and between currency areas: How far away is EMU?", The Review of Economics and Statistics, vol. 76(2), pp. 236-244.

Westerlund, J. (2007) "Testing for Error Correction in Panel Data", Oxford Bulletin of Economics and Statistics, vol. 69(6), pp. 709–748.

Appendix

TABLES

Table A: Pairwise correlation matrix of national misalignments (1985-2009)

CEDEAO	MES_BEN	MES_BFA	MES_CIV	MES_MLI	MES_NER	MES_SEN	MES_TGO	MES_GHA	MES_GMB	MES_NGA	MES_SLE
MES_BEN	100.0										
MES_BFA	13.9	100.0									
MES_CIV	77.6a	30.0d	100.0								
MES_MLI	-20.9	82.3a	-0.4	100.0							
MES_NER	11.6	89.4a	38.9c	82.1a	100.0						
MES_SEN	38.8c	88.4a	58.2a	71.4a	91.0a	100.0					
MES_TGO	23.4	-51.6a	38.5c	-54.2a	-30.6d	-25.5	100.0				
MES_GHA	*-22.7*	*80.7a*	*-4.8*	*86.8a*	*73.5a*	*63.3a*	*-67.3a*	100.0			
MES_GMB	*-7.7*	*13.7*	*-0.4*	*41.4b*	*11.7*	*20.1*	*-38.7b*	**49.7b**	100.0		
MES_NGA	*-44.0b*	*10.8*	*-68.2a*	*40.0b*	*-4.7*	*-11.8*	*-67.4a*	**46.7b**	**50.8a**	100.0	
MES_SLE	*-62.6a*	*37.9c*	*-43.8b*	*65.5a*	*33.6c*	*16.9*	*-53.7a*	**74.7a**	**54.0a**	**65.2a**	100.0

Notes : a, b, c, d correspond respectively to 1%, 5%, 10% and 15% significance level,
In bold: WAMZ area' correlations; In italics: cross regional correlations (WAEMU-WAMZ).

CFA	MES_BEN	MES_BFA	MES_CIV	MES_MLI	MES_NER	MES_SEN	MES_TGO	MES_CAF	MES_CMR	MES_COG	MES_GAB	MES_GNQ	MES_TCD
MES_BEN	100.0												
MES_BFA	13.9	100.0											
MES_CIV	77.6a	30.0d	100.0										
MES_MLI	-20.9	82.3a	-0.4	100.0									
MES_NER	11.6	89.4a	38.9c	82.1a	100.0								
MES_SEN	38.8c	88.4a	58.2a	71.4a	91.0a	100.0							
MES_TGO	23.4	-51.6a	38.5c	-54.2a	-30.6d	-25.5	100.0						
MES_CAF	*14.4*	*20.5*	*10.8*	*-14.2*	*6.2*	*7.6*	*12.2*	100.0					
MES_CMR	*55.4a*	*50.1b*	*65.2a*	*44.0b*	*55.3a*	*74.8a*	*-16.1*	**-35.7c**	100.0				
MES_COG	*29.8d*	*-9.6*	*6.5*	*-16.0*	*-2.4*	*5.5*	*-17.6*	**-31.0d**	**40.0b**	100.0			
MES_GAB	*35.1c*	*78.7a*	*36.8c*	*67.3a*	*76.0a*	*84.4a*	*-51.2a*	**-8.4**	**78.1a**	**25.0**	100.0		
MES_GNQ	*3.8*	*64.5a*	*-5.5*	*71.8a*	*58.7a*	*64.1a*	*-68.1a*	**-29.7d**	**58.0a**	**29.3**	**80.6a**	100.0	
MES_TCD	*50.2b*	*35.8c*	*40.3b*	*32.6d*	*43.9b*	*48.6b*	*0.4*	**-11.8**	**58.1a**	**33.1c**	**51.8a**	**29.8d**	100.0

Notes : a, b, c, d correspond respectively to 1%, 5%, 10% and 15% significance level
In bold: CAEMC area' correlations; In italics: cross regional correlations (WAEMU-CAEMC).

CAEMC_WAMZ	MES_CAF	MES_CMR	MES_COG	MES_GAB	MES_GNQ	MES_TCD	MES_GHA	MES_GMB	MES_NGA	MES_SLE
MES_CAF	100.0									
MES_CMR	-35.7c	100.0								
MES_COG	-31.0d	40.0b	100.0							
MES_GAB	-8.4	78.1a	25.0	100.0						
MES_GNQ	-29.7d	58.0a	29.3	80.6a	100.0					
MES_TCD	-11.8	58.1a	33.1c	51.8a	29.8d	100.0				
MES_GHA	*-13.4*	*42.3b*	*4.4*	*66.6a*	*69.6a*	*29.2*	100.0			
MES_GMB	*-69.4a*	*61.7a*	*32.8d*	*36.4b*	*47.7b*	*17.4*	**49.7b**	100.0		
MES_NGA	*-30.6d*	*0.2*	*19.8*	*20.5*	*49.1b*	*11.8*	**46.7b**	**50.8a**	100.0	
MES_SLE	*-39.7b*	*7.9*	*-0.9*	*19.0*	*45.2b*	*-0.4*	**74.7a**	**54.0a**	**65.2a**	100.0

Notes : a, b, c, d correspond respectively to 1%, 5%, 10% and 15% significance level
In bold: WAMZ area' correlations; In italics: cross regional correlations (CAEMC-WAMZ).

Table B: Variables definitions and data sources

Variable	Description	Source
Reer	Calculated as the NEER deflated by relative weighted prices.	*Authors calculations*
Neer	Nominal effective exchange rate is a weighted average of nominal bilateral exchange rates against the main trading partners.	*World Development Indicators (World bank)*
Weights	The share of first ten partners in imports and exports of goods and services of the considered country over the 1996-2009 subperiod.	*Direction of Trade Statistics (IMF)*
Prod	Corresponds to the real PPP GDP per capita of the considered country relative to its main trading partners, using the same weights as for the calculation of the REER series.	*World Development Indicators (World bank) and Authors calculations*
Nfa	Net foreign Asset position as a percent of GDP	*Lane and Milesi-Ferretti (2007) database*
Tot	Weighted average price of the three main commodities exported by the country deflated by the unit value of OECD countries' manufactured exports.	*Couharde et al. (2012b)*
Open	Sum of imports and exports as a percent of GDP	*World Development Indicators (World bank)*
Gov	Government consumption as a percent of GDP	*World Development Indicators (World bank)*

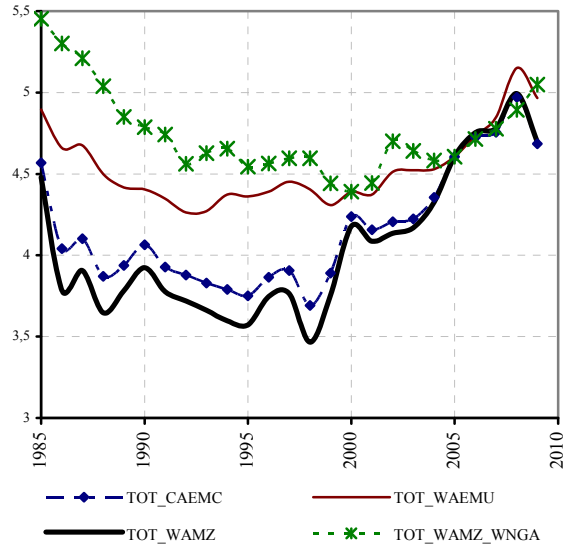
Countries retained in our study are:
Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea and Gabon for the CAEMC.
Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo for the WAEMU.
Gambia, Ghana, Nigeria and Sierra Leone for the WAMZ.

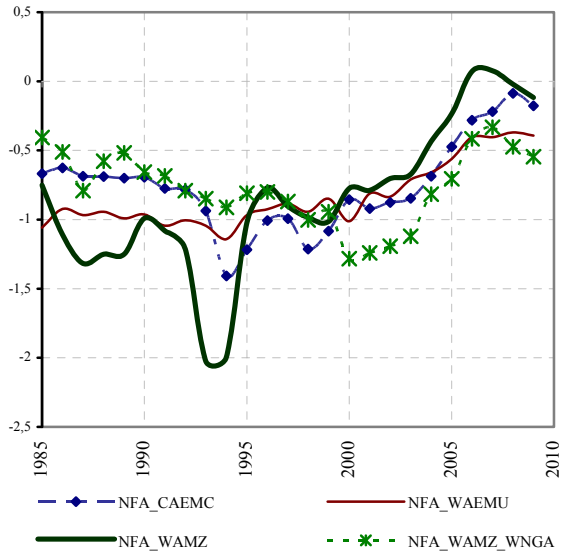
Table C: Lance and Williams (1967)'s recurrence formula parameter values

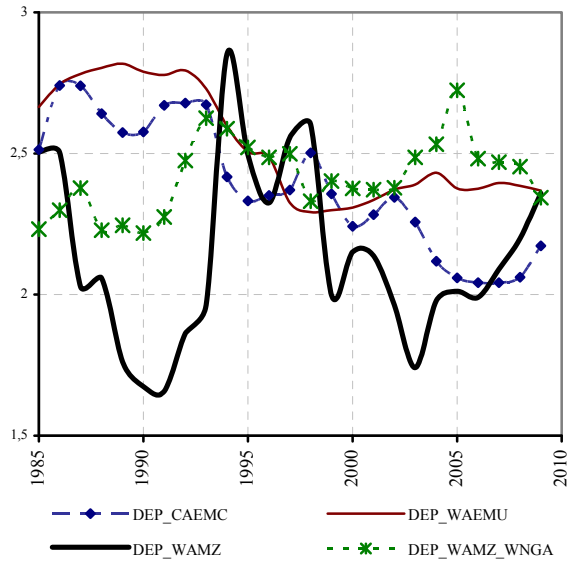
Clustering linkage method	α_i	α_j	β	γ
Single	1/2	1/2	0	–1/2
Centroid	$\frac{n_i}{n_i + n_j}$	$\frac{n_i}{n_i + n_j}$	$-\alpha_i \alpha_j$	0
Ward's	$\frac{n_i + n_k}{n_i + n_j + n_k}$	$\frac{n_i + n_k}{n_i + n_j + n_k}$	$\frac{-n_k}{n_i + n_j + n_k}$	0

FIGURES

Figure A1: Evolution by region of economic fundamentals







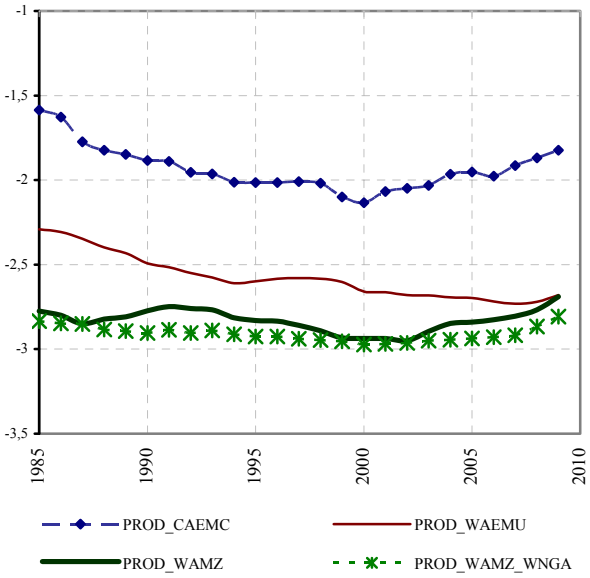
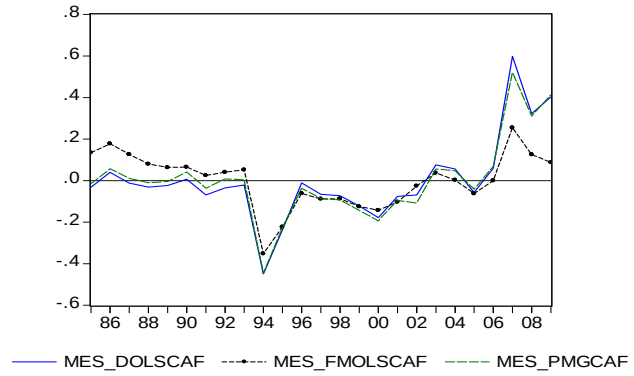
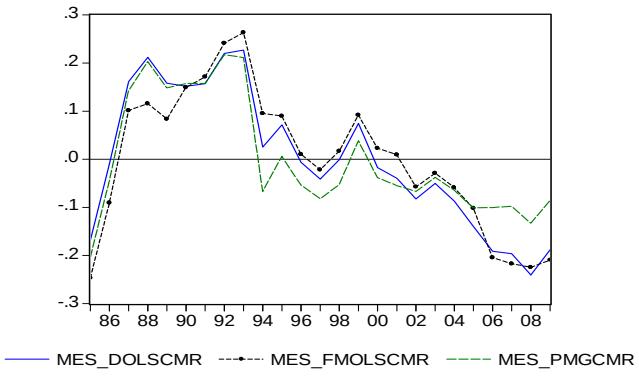
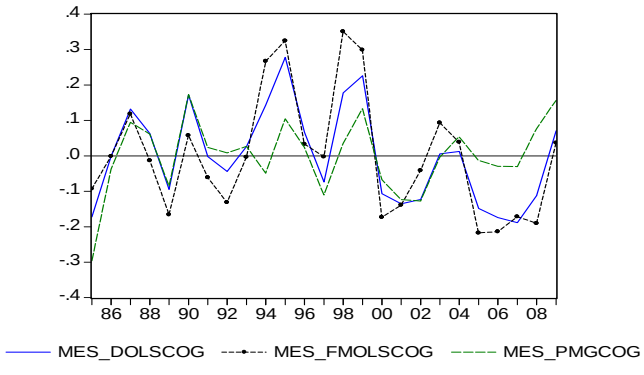


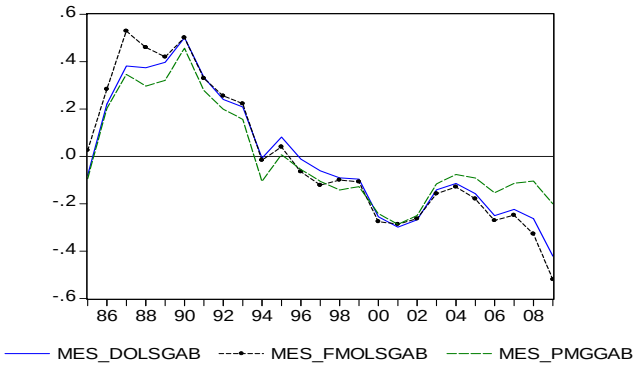
Figure A2: Evolution of exchange rate misalignments

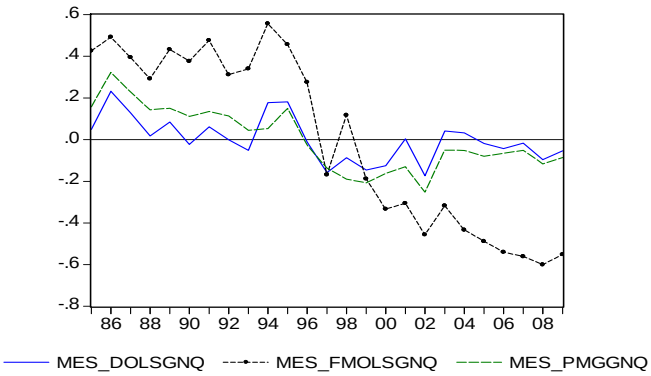
Misalignments of the CAEMC countries

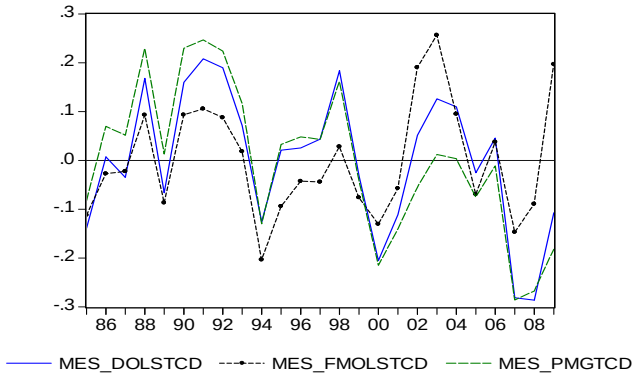


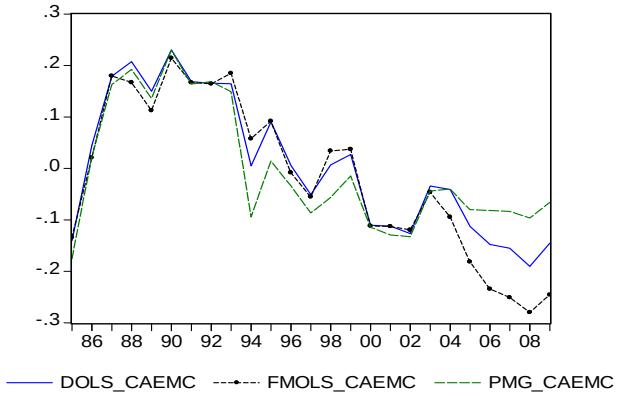




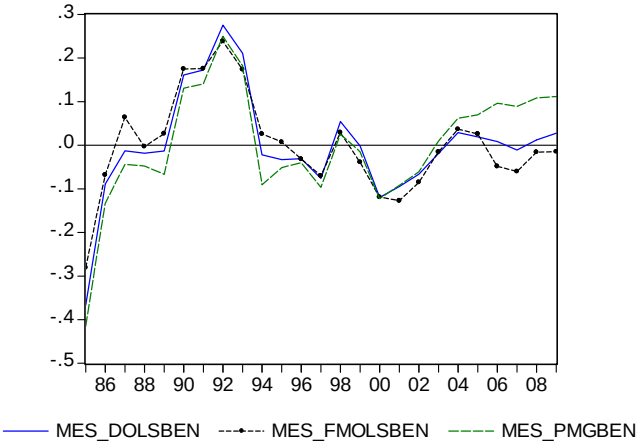


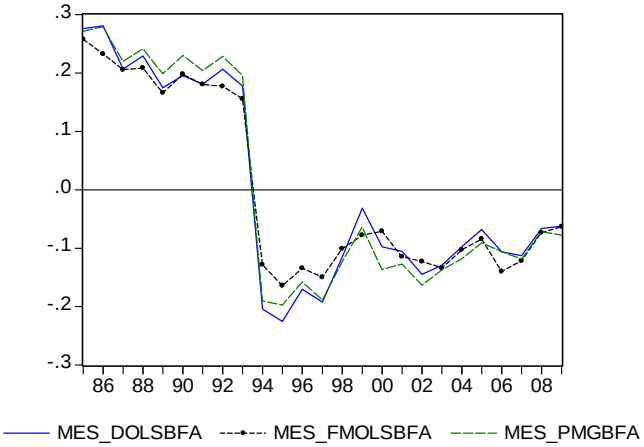


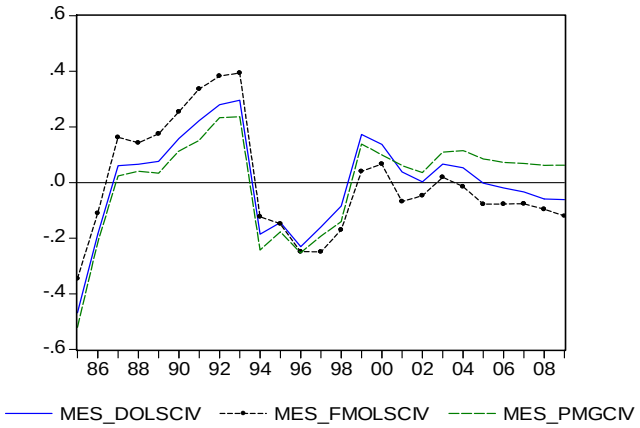


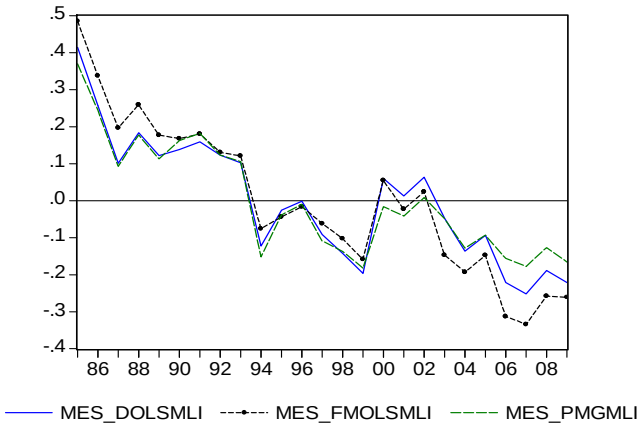


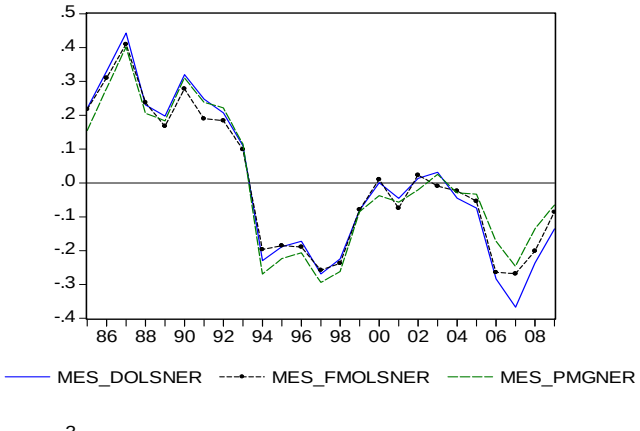
Misalignments of the WAEMU countries

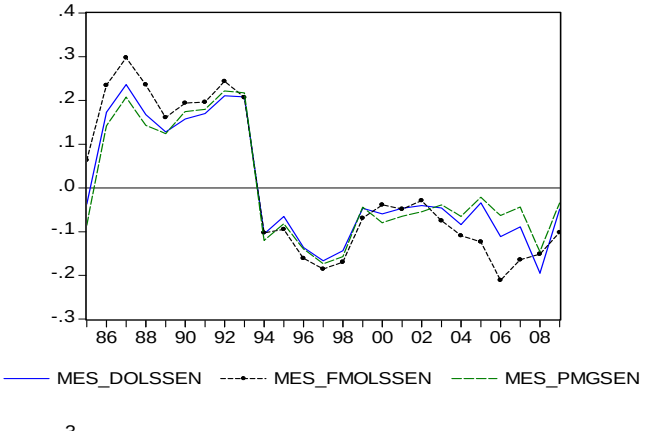


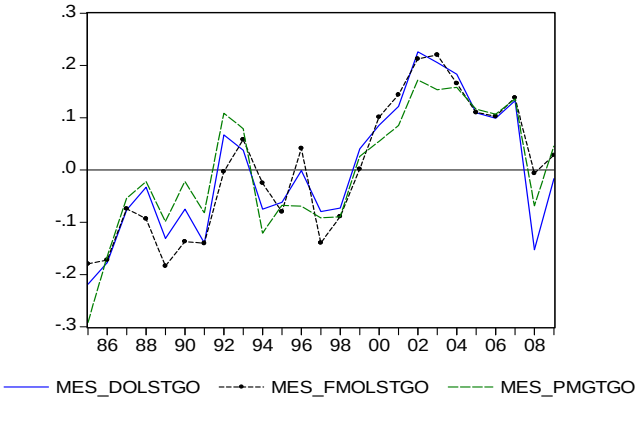


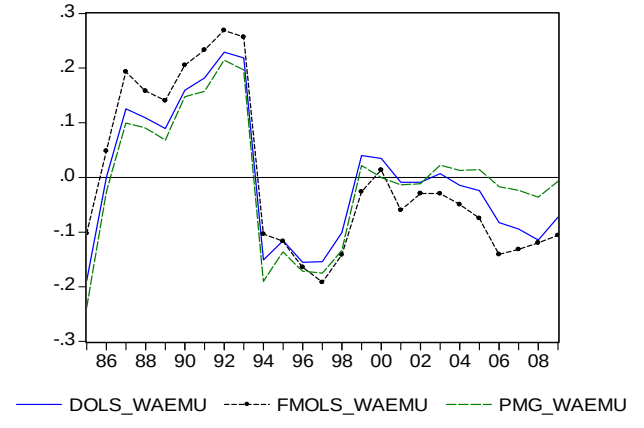












Misalignments of the WAMZ countries