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Two Monetary Unions in West Africa observed from a viewpoint of Real Effective Exchange Rates: 1999-2008

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Two Monetary Unions in West Africa observed from a viewpoint of Real Effective Exchange Rates:1999-2008[†]

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Abstract

West Africa has two economic integrations—West African Economic and Monetary Union (WAEMU) and Economic Community of West African Countries (ECOWAS). WAEMU is composed of eight countries and has issued a unique legal tender, the CFA franc, while ECOWAS is a wider economic integration of 15 countries, including all WAEMU member countries. It aims to develop itself into a monetary integration and custom union.

In this paper, we begin by calculating the monthly real effective exchange rate (REER), nominal effective exchange rate (NEER), and effective relative price index (ERPI) for 13 West African countries for the period 1999–2008, using consumer prices and trade weights to reflect their trade partners' shift over time. We then analyse the fluctuations of these series and find that WAEMU members tend to be more stable than non-WAEMU members. Against our expectations, the REER of WAEMU member countries did not appreciate, even though the euro, to which the CFA franc was pegged, appreciated against the US dollar by around 40% during the same period. Finally, we test whether the PPP theory holds in this context and find that it tends to hold for WAEMU members rather than for other countries with more flexible exchange rate systems.

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Keywaords: West Africa, Real Effective Exchange Rates, Monetary Union

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1. Introduction

In West Africa, there are two economic integrations—West African Economic and Monetary Union[i] (WAEMU) and Economic Community of West African Countries (ECOWAS). Established in January 1994, WAEMU is composed of the following eight countries: Burkina Faso, Benin, Cote d'Ivoire, Niger, Mali, Senegal, Togo, and Guinea-Bissau. All of these countries are also members of the West African Monetary Union (WAMU[ii]), which was formed in 1962 and revised in 1974, and was responsible for issuing a unique legal tender, the CFA franc (Communauté Financière Africaine franc)[iii]. The CFA franc was issued by WAMU through the regional central bank BCEAO (Banque Centrale d'États d'Afrique de l'Ouest). When WAEMU was created, it was designed to be a body that would eventually subsume and replace WAMU[iv]. Despite this, both bodies still exist; WAMU has yet to be entirely replaced by WAEMU. In this paper, for the purpose of avoiding confusion, we use WAEMU when we refer to the economic integration comprised of these eight countries, except in contexts related to the monetary union.

[Figure 1 here]

ECOWAS is a wider economic integration composed of 15 countries, including all the members of WAEMU. ECOWAS aims to develop itself into a monetary integration as well as a custom union. As part of this plan, in 2000, ECOWAS proposed to establish a new common currency named 'ECO', which would be used across all ECOWAS countries, including those in WAEMU. In concrete terms, the plan was to be rolled out in two phases: first, the establishment of a second monetary zone among non-WAEMU countries, and second, the merging of WAMZ and WAMU. In April 2000, seven countries (Cape Verde, the Gambia, Ghana, Guinea, Liberia, Nigeria, and Sierra Leone) signed the Accra Declaration seeking to establish the Second Monetary Zone in West Africa. However, Liberia and Cape Verde decided to become observers and only the remaining five countries signed the Bamako Accord in December 2000, which indicated the concrete institutional and legal framework of the West African Monetary Zone (WAMZ) and the West African Monetary Institute (WAMI).

WAMZ aimed to launch a unique currency as well as a central bank by the end of 2003 and merge with WAMU by 2004. However, the members are facing difficulties in clearing the required convergence criteria, and the Authority of Heads of State

and the government of the WAMZ thrice decided to postpone its introduction. In recent years, a new push has been witnessed. On 16 February 2010, Liberia acceded to the membership of WAMZ, and the ECO is scheduled to be launched by 2015 and to replace the CFA Franc of WAMU by 2020. However, this proposed merger also faces obstacles because of the particularity of the institution of WAMU, which is detailed below.

Despite the introduction of the euro in 1999, the WAMU treaty is based around the following four principles: First, the parity of the CFA franc to the French franc (the euro after 1 January 1999) is fixed. Second, the unlimited convertibility of the CFA franc to the French franc/euro is guaranteed by the French government. Third, in return for this guarantee, the BCEAO must pool 50% (the rate was 65% until September 2005) of its external reserves in a special operation account called *compte d'opération*, which has been opened at the French Treasury. Fourth, in principle, no capital control between France and WAMU countries is guaranteed, while CFA franc notes outside the region have not been repurchased by the Central Bank since 1993. In other words, the institution of WAMU is viable only because of the intervention of the French Treasury. After the proposed mergers, African countries will have to choose between two courses: establish real economic

independence of WAMU members from the former colonial power France or admit WAMZ countries to participate in this special operation account opened at the French Treasury.

[Figure 2 here]

Under this uncommon system, the value of the CFA franc has been relatively stable compared to other African currencies. Over a period of 60 years, from 1948 to 2010, it has been devaluated only once, by 50%, on 11 January 1994. Since then, the parity of the CFA Franc has been adjusted to 100 CFAF/FF, and, since the introduction of the euro in January 1999, the CFA franc has been fixed at the rate of 655.957CFAF/euro, because the French franc was pegged at a rate of 6.55957 FF/euro. However, the value of the euro appreciated between July 2001 and August 2008, and the reduced price competitiveness of WAEMU members in the world market has been a concern.

Figure 2 shows how the value of the US dollar has been related to the value of each of the currencies of West African countries between 1999 and 2008. As the West African currencies appreciate, the line moves higher up the figure. The figure

clearly shows that over the period of 1999–2008, the CFA franc and the Cape Verde escudo, which are both pegged to the euro, appreciated against the US dollar, while the other currencies depreciated on a grand scale.

In this study, we first calculate the real effective exchange rate (REER) from 1999 to 2008 for the following 13 countries in West Africa: Benin (BE), Burkina Faso (BF), Côte d'Ivoire (CI), Guinea Bissau (GB), Mali (ML), Niger (NI), Senegal (SE), Togo (TO), Nigeria (NI), Ghana (GH), Guinea (GU), the Gambia (GA), and Cape Verde (CV). We exclude Liberia and Sierra Leone from our data set because of their economic instability in the period leading up to the early 2000s, due to their civil conflicts. The REER indicates transitions in the competitiveness of a country. A trend appreciation of the REER is considered to represent an unfavourable trend for export growth, while it indicates that imports are promoted. Both incur the risk of restraining the development of their industrial sectors. The REER is obtained by adjusting the nominal effective exchange rate (NEER) for relative prices between the home country and its trade partners. The NEER is a weighted average of major bilateral nominal exchange rates, with weights based on trade shares.

Next, we break down the REER into two factors—the NEER and the effective relative price index (ERPI)—in order to examine the factors of each REER transition.

In the third stage of our investigation, we test whether the purchasing power parity (PPP) theory holds for the above West African countries and examine whether the result varies between countries with a fixed exchange rate and those without.

2. Some discussions concerning the calculation of the REER

The REER is used to measure international price and cost competitiveness. The International Monetary Fund (IMF) periodically releases the REERs of most of its members through the International Financial Statistics (IFS), which are based on the IMF's Information Notice System. This system came into existence in 1983 to facilitate surveillance of the exchange rate policy of Fund members (see Zanello and Desruelle, 1997). The REER is obtained by adjusting the NEER for inflation differentials with important trade partners. The NEER is a weighted average of major bilateral nominal exchange rates, with weights based on the trade shares reflecting the relative importance of each country. Therefore, the choice of trade weights and price series is critical when calculating the REER as well as the NEER.

With regard to weights, Golub and Ceglowski (2002) propose the following six weighting schemes: total export plus imports, manufactured exports plus imports, total exports, total imports, manufactured exports, and manufactured imports. In

this study, we focus on West African countries, which are among the less industrialised countries. Therefore, our alternatives are restricted to the following three: total export plus imports, total exports, or total imports.

In general, the export partners of developing countries are not identical to their import partners, which accounts for the difference of transition between export-based and import-based REERs. South African REERs, which were calculated by Golub and Ceglowski (2002) using six alternative weights, show that there is surprisingly little variation in REERs when weights vary. Edwards (1989) also concludes that the choice of countries as trading partners may have little impact on the REER of a country (p.126). However, as we calculated in a previous work with regard to the REERs of eight WAEMU countries, import-based REERs exhibited significantly different trends from those of export-weighted REERs.

On this subject, research undertaken by prominent specialists for West African countries, Jeanneney and Parire (1991), indicates that the validity of using export data as a basis for trade weights is questionable; this is because most developing countries export mainly primary products to large international markets, using a few large international companies as intermediaries. Therefore, Jeanneney et al. support the use of total import data for calculating trade weights. On the other

hand, Opoku (2002) finds that export-based REERs are advantageous for developing countries whose export products are dominated by primary commodities because, in this situation, prices are determined by the international market.

In reality the destinations of exported goods from West African countries are very diverse, as Appendix I indicates. Moreover, to garner an understanding of the competition among the studied countries in the foreign market, we should consider the impact of not only a country's import partners but also its export partners on the country's REER. Indeed, despite the fact that their weighting scheme is laborious, the IMF's REER indices are treated as standard import and export weights (see Zanello and Desruelle, 1997).

Second, the use of fixed weights or changing weights has also been argued as an effective means of calculating the REER. In general, when calculating the REER, the trade weight is fixed over a period of time—for example, one year or an average of a few sample years. However, in today's globalised reality, trade partners are not fixed but rather shift drastically. Therefore, we try to obtain a REER that reflects this shift in trade partners by calculating it under some restricted condition.

In terms of price indices, Golub and Ceglowski (2002) also suggest the following six alternatives: the consumer price index (CPI), the wholesale price index (WPI),

GDP deflators, export unit value, import unit value, and unit labour costs in manufacturing. In general, the CPI is not considered to be a very suitable index for calculating the REER because it is affected by the prices of non-traded goods. Golub and Ceglowski (2002) explain this disadvantage in more detail as follows. First, CPIs may be distorted by price controls and excise taxes. Second, CPIs may not accurately reflect the prices of intermediate goods, which have become an increasingly important part of manufacturing trades. Third, a relative decline in the CPI associated with 'pricing to market' may not signify an improvement in competitiveness but rather a temporary reduction in profit margins. Fourth, CPIs are endogenous to the exchange rate because currency depreciation raises import prices and pushes up the CPI. However, CPIs are considered to have some advantages over WPIs and GDP deflators, particularly the fact that they are available on a timely basis.

Golub and Ceglowski (2002) also indicate relative export and/or import unit values excluding non-traded goods instead of the CPI. However, according to them, this method has the following disadvantages: first, they may be heavily influenced by short-run pricing to market and they are not exogenous to the exchange rate; second, they may be heavily weighted by the prices of primary products and thus

fail to reflect the endogenous effects of international competitiveness on the composition of goods that are exported and imported; third, for many countries, unit value data are not available on a timely basis.

Since the 1990s, REERs based on unit labour costs in manufacturing (REER-ULCs) have become recognized as the best single indicator, especially for developed countries (Turner and Van't Dack, 1993). These weights are computed for trade in manufactured goods, taking into account competition between imports and locally-produced import-substitution goods, competition between a country's own exports and locally produced foreign goods, and competition between local exports and the exports of other countries in third markets (Zanello and Desruelle, 1997). In the manufacturing sector, unit labour costs are calculated by dividing labour costs by output per worker. The IMF regularly calculates the REER-ULC for 21 industrial countries and 23 newly industrialized, developing, and transition countries (Turner and Golub, 1997). However, not only do these weights not have important significance for non-industrial countries, there is also the challenge that REER- ULCs are not available on as timely a basis as CPIs.

As mentioned above, several types of REER exist, and this means that there is some difficulty in choosing which indices are most appropriate. Each set of indices

has some shortcomings, and those indices that are less deviated cannot be obtained by simple calculation. There is an overwhelming difficulty with investigating this issue for developing countries because the research is limited by insufficient data availability and accuracy. Therefore, the appropriate method should be selected bearing in mind the purpose of the research and by acknowledging and addressing each shortcoming. The REER-CPIs of the following West African countries are obtained from the IFS: Côte d'Ivoire, Togo, Nigeria, Ghana, the Gambia, and Sierra Leone. However, the IMF does not publish the REER of other West African countries.

Our main investigation focuses on comparing the REERs of different West African countries, each of which is derived using an identical method. We then use this data to assess whether or not the planned monetary union is appropriate. For instance, if the REERs of those WAEMU members that share a unique currency are found to be divergent, then it follows that this monetary union might burden the members. On the other hand, the comparisons between the REERs of WAEMU members and those of their neighbours whose exchange rates are depreciating could indicate whether or not the new monetary integration under consideration since 2000 is realizable.

3. Methodological overview

The REER in foreign currency terms at each period t is represented as $REER^t$.

$REER^t$ is expressed by equation (1) as follows (See Hinkle and Montiel, 1999, 49):

$$REER^t = \prod_{i=1}^{m} \left[\frac{E_i^t}{P_i^t} \right]^{w_i^t} \bullet P_d^t \text{ , (1)}$$

where E_i^t represents the nominal exchange rate indices for each foreign country i, expressed by the units of foreign exchange per unit of domestic currency at each period t. With respect to t, we conduct an analysis of each monthly period from 1999 to 2008. Thus, the calculations are performed over 120 time periods. P_i^t and P_d^t are the general price indices of foreign country i and the domestic country, respectively. $\prod$ indicates the product of the bracketed terms of m countries. The geometric averaging method is used, where w_i^t is the domestic country's trade weight for each foreign trade partner $i\,(i=1,2\ldots m)$ at each period t.

The sum of weights equals one as follows:

$$\sum_{i=1}^{m} w_i^t = 1 \text{ . (2)}$$

The above equation can be rewritten as follows:

$$P_d^t = \prod_{i=1}^{m} {P_d^t}^{w_i^t} \quad . (3)$$

Based on equation (3), equation (1) is expressed by equation (4) as follows:

$$REER^t = \prod_{i=1}^{m} \left[\frac{E_i^t}{P_i^t} \right]^{w_i^t} \bullet P_d^t$$

$$= \prod_{i=1}^{m} \left[\frac{E_i^t \bullet P_d^t}{P_i^t} \right]^{w_i^t}$$

$$= \prod_{i=1}^{m} {E_i^t}^{w_i^t} \bullet \prod_{i=1}^{m} \left[\frac{P_d^t}{P_i^t} \right]^{w_i^t} \quad . (4)$$

As mentioned above, $E_{i_i}^t$ is the bilateral nominal exchange rate index between the domestic country and a foreign country i, expressed as the foreign exchange per unit of domestic currency at period t. Therefore, the geometric average of the nominal exchange rate, weighted by the trade amount of each partner, $\prod_{i=1}^{m} {E_i^t}^{w_i^t}$, reflects the NEER in foreign currency terms at each period t ($NEER_i^t$). Moreover, the geometric average of the relative price indices, as weighted by the trade amount for each partner i, $\prod_{i=1}^{m} \left[\frac{P_i^t}{P_d^t} \right]^{w_i^t}$ is considered as an effective relative price index ($ERPI_{id}^t$). Consequently, the index $REER^t$—the weighted average of a country's currency relative to an index of other major currencies adjusted for the effects of inflation—is composed of two indices as follows:

$$REER^t = NEER^t / ERPI^t \quad (5)$$

Equation (5) indicates the price increase of the trade partners relative to domestic prices; in sum, a rise in the value of $ERPI_{id}^t$ decreases the value of $REER^t$. This equation represents the depreciation of the domestic currency.

4 Dataset

4.1 Trade weights

Trade weights are simply calculated by dividing the sum of the import and export values with each trade partner by each home country's total trade value. The data for the calculation are obtained from the IMF's *Direction of Trade*. The unique aspect of this study is its investigation of the monthly changing weight for those countries, beside the countries of three euro/CFA regions, whose trade values are important throughout the period 1999–2008. The euro/CFA zone is composed of twenty-six countries and is divided into three groups: euro (twelve), WAEMU (eight), and CEMAC (six) (see Table 1).

[Table 1 here]

For each home country, we first determine the trade value (sum of exports and imports) within the euro/CFA zone for each month during the period 1999–2008. Second, we determine the other top ten trade partners for each home country from the perspective of total trade value between 1999 and 2008. However, we lacked data for some important trade partners of each home country, such as data on the monthly average nominal exchange rate with each home country and data on pricing. In cases like these, we removed the countries in question and the following countries were moved up. Third, for each home country, for each month, we determined the trade values for the euro/CFA zone as well as for the other top ten trade partners. The difference between the sum of the trade value for these thirty-six countries and the total trade value was calculated, and this figure was considered to represent the trade value for the rest of the world. Fourth, the trade value for each trade zone/partner was calculated as a percentage, relative to the total trade value (see Appendix I).

4.2 Benchmark

From the viewpoint of the validity of purchasing power parity (PPP), it is favourable to evaluate a time period that is sufficiently long such that the data

series does not become nonstational. However, longer periods themselves often involve a larger risk of structural change. Notably, the economies of developing countries tend to be less diversified and can be easily affected by external shocks. In fact, countries in the CFA franc zone were affected by the devaluation of the CFA in 1994. On the other hand, in 1997, the Asian financial crisis disturbed the exchange rates in the global markets. Therefore, we chose January 1999 as the benchmark period; at this point, the effects of the 1997 collapse of Asian currencies as well as the 1994 devaluation of the CFA franc were relatively insignificant. This period was also suitable as it coincides with the euro's introduction.

4.3 Currency rate

The bilateral historical exchange rates between each country and their trade partners are available on the OANDA website[v]. We downloaded the monthly average rates (interbank rates) for each country's currency for the period between January 1999 and December 2008, as expressed by the units of each trade partner's exchange. In January 1999, the value is indexed at 1. With respect to the rest of the world, we use the conversion rates expressed by the units of the Special Drawing Rights (SDR) per currency.

4.4 Price indices

For price indices, we decided to use CPIs due to the issue of data availability, despite the shortcomings discussed in the previous section. The price indices of the entire euro area and for each country (with the exception of Cuba) are obtained from the IFS[vi]. The database includes annual price data from 160 countries; hence, there is no more appropriate database. On the other hand, the annual price growth rates of the WAEMU area were obtained from *Annuaire Statistique 2007*, which lists price growth rates until the year 2007, and from the *Bulletin Mensuel Conjoncture de la BCEAO, Janvier 2009*, which lists the data for the year 2008. The price growth rates of the CEMAC are obtained from the website of the Banques des Etats de l'Afrique Centrale (BEAC)[vii]. However, most of these data are not monthly but rather reflect annual price growth rates. Therefore, we transformed the data into monthly price indices with the assumption that the inflation rate within the year was constant; this calculation was constructed as follows:

$$g_m^n = (g_m^a + 1)^{\frac{1}{12}} - 1, \ (n = 1,2,3.....12),$$

where g_m^n is the nth month's growth rate for consumer prices in year m and g_m^a is the annual growth rate for consumer prices in year m. When the price index of January 1999 is fixed at 1—that is, $Q_{1999}^1 = 1$—the price index for January

in year m is obtained as $Q_m^1 = (1+g_{m-1}^n)Q_{m-1}^{12}$, and n monthly consumer price index in year m is described as $Q_m^n = (1+g_m^n)Q_m^{n-1}$ $(n \neq 1)$.

5. Results

Figures 3 and 4 depict the evolution of the REER for each member country of WAEMU and WAMZ respectively. Shifts to the upper or lower side respectively imply appreciation or depreciation of each REER. According to Figure 3, overall, the external competitiveness of each country improved until around mid-2000. The REERs continued to appreciate until the first half of 2004, due to the rise of the euro against the US dollar. Thereafter, excluding the REERs of Burkina Faso and Niger, all of the REERs remained stable and did not experience any fluctuation over 10% compared to the initial value, while the euro, to which their currencies are pegged, continued to appreciate up to mid-2008. This implies that, contrary to our initial expectation, the REERs of WAEMU members (with the exception of Burkina Faso and Niger) have succeeded in avoiding strong appreciation. Furthermore, the REERs of these six WAEMU members do not diverge widely. The REER of Cape Verde, whose currency is also pegged to the euro, is less divergent, as shown in Figure 4.

As Figure 4 makes clear, the REERs of the WAMZ countries are much more divergent. For example, in general, Nigeria's REER is seen to appreciate after January 2004, while Ghana's REER also shows a fluctuation similar to that of Nigeria in the period after 2001; the sharp depreciation of the REER at an early date absorbed the effects of this appreciation. As Figure 2 makes clear, the nominal exchange rate of the Nigerian naira to the US dollar also depreciated. However, the Nigerian REER appreciated far more than those of WAEMU member countries. After the creation of WAMZ, its unification with WAEMU is planned. But as our research makes clear, sustaining a common currency among these countries, even if it can be successfully introduced, might prove to be a challenging task.

[Figure 3 here]

As for the WAEMU countries where a single currency had been introduced, their different REERs seemed to reflect only the difference in their respective combination of trade partners (see Appendix I). The strong depreciation in' Niger's REER in the second half of 2006 was caused by the considerable rise in the amount of transactions with Russia, where inflation continued to increase. In contrast, the

sharp appreciation of Niger's REER since mid-2008 was a result of the sudden increase in the amount of uranium being exported to Japan, which has suffered from persistent deflation. In July 2008, Japan accounted for 58% of Niger's total trade, a figure that rose to 72% in September of the same year.

Furthermore, the strength of the REER of Benin since mid-2003, in comparison with the other WAEMU members, seems to be a result of an appreciation of the NEER and a reduction in the value of the ERPI (see Figure 5). The appreciation of the NEER was caused by the increase in the trade share of China, whose currency, the yuan, was pegged to the US dollar until mid-2005. The yuan has remained undervalued—from the perspective of its trade surplus and the amount of its accumulated exchange reserves—even after the introduction of the adjustable peg system. By the end of 1999, about 40% of Benin's trade was conducted with the European Union (EU), while its trade transactions with China had been a very small percentage. Subsequently, by the second half of 2008, only 12–18% of Benin's trade was conducted with the EU, and the share of exports to China increased to 37–43%. In contrast, the reduction in the ERPI was induced by the price increases in Benin. In comparison to the initial value, prices in Benin increased more than 30% in the second half of 2008.

[Figure 4 here]

[Figure 5 here]

[Table 2 here]

We next determine the effects of the NEER and the ERPI on the REER. Figure 5 shows each index's fluctuation for each country. By using this together with Table 2, it is clear that the REERs of WAEMU member countries fell below the NEERs, due to the effect of the offset prompted by rises in ERPIs, with the exception of the case of Benin since 2006. This means that the consumer price growth rates of WAEMU members became much lower than those of their trade partners in the period under consideration. Cape Verde and Guinea also demonstrate the same tendency. In contrast, in the other WAMZ countries, the REER values tended to be higher than their NEER values. This implies that their ERPI tended to be smaller than 1; in other words, their prices tended to rise compared to those of their trade partners. This is especially true in the case of Nigeria, where the ERPI decreased so rapidly that it remained lower than the NEER since mid-2001. Consequently, the Nigerian REER appreciated regardless of

the depreciation of the NEER.

[Table 3 here]

We examine the REERs from the perspective of variability. In this paper, variability is simply defined as the standard deviation of the natural log difference[viii], and it indicates the magnitude of fluctuation. The coefficients of variation (CV) show the dispersion of the data during the surveyed period[ix]. Figure 6 shows the relationship between the variability and the CV of both the REER and the NEER. On the diagonal line of the figure on the left, the value of the variability of the REER converges with that of the NEER. As evident from Table 2 and Figure 6, in most of the countries, both the variability and the CV of the NEER are larger than those of the REER. This means that both the magnitude of fluctuation and the dispersion of the NEER were set off by those of the ERPI.

Second, Figure 6 indicates that the fluctuations of the NEERs and REERs of Mali, Burkina Faso, Benin, and Senegal are relatively stable, while those of Guinea and the Gambia are not. Table 3 organizes the characteristics of the REER variation for the 13 West African countries from the viewpoint of both variability and the CV.

The table shows that the real effective exchange rates of countries that are members of WAEMU were more stable than those that are members of WAMZ.

[Figure 6 here]

6. Test of PPP of West African countries

The PPP theory holds that the nominal exchange rate between two currencies should be equal to the ratio of aggregate price levels between those two countries, so that a unit of currency of one country will have the same purchasing power in a foreign country (Taylor and Taylor, 2004). Although this theory has attracted significant attention over several centuries of scholarship, the PPP definition that is now the most familiar was first introduced by Cassel (1922), who was a significant contributor to the international policy debates concerning the appropriate level for nominal exchange rates that were held after World War I. His definition was later developed by Balassa (1964) and Samuelson (1964).

The PPP theory holds that the variance of the rate of change in an exchange rate will correspond to the variance of international inflation differentials. However,

several studies have found evidence showing persistent deviation from the PPP theory (Frenkel, 1981; Edwards, 1989b; Taylor, 1988).

The PPP theory is founded on three assumptions: (1) the law of one price, (2) the implementation of arbitrage transactions, and (3) the absence of friction such as tariff barriers, quantitative restrictions, transportation costs, and inflation differentials in traded and non-traded goods (the Balassa-Samuelson effect). In general, it has been found that the PPP theory does not hold true in the short run. However, in the long run, the evidence suggests that the PPP theory might hold. The evidence seems to imply that the real exchange rate attains an equilibrium level in the long run even if it has deviated in the short run. We test this PPP theory on West African currencies using the derived NEER, ERPI, and REER data.

From equation (5), we have the following equation :

$$r_t = n_t - p_t, \quad (6)$$

where r_t, n_t, and p_t are the natural logarithms of the REER, NEER, and REER series, respectively. For the relative PPP to hold, r_t must be stationary or the relationship between n_t and p_t must be stationary. Although the PPP theory can be tested in multiple ways, in this paper, we investigate the following: (1) whether

r_t is stationary (using the unit root test under the augmented Dickey-Fuller (ADF) regression assumption) and (2) whether Engel-Granger's cointegration analysis can be used between the nominal exchange rate n_t, relative prices, and p_t.

6.1 Unit root test (test for whether r_t is stationary)

We test whether r_t is stationary on data from thirteen West African countries. If the ADF test rejects the null hypothesis of unit root ($\delta = 0$) in the following models, then series r_t must be considered stationary.

First, the unit root test was tested with the following p-th order autoregressive model with intercept and trend (equation (7)). The lag difference was determined according to the Schwarz Info Criterion

$$\Delta r_t = a_0 + a_1 t + \delta r_{t-1} - \sum_{i=1}^{p} \gamma_i \Delta r_{t+1-i} + \varepsilon_t, \quad (7)$$

$$H_0 : \delta = 0.$$

In the case that the null hypothesis of the unit root was not been rejected in the above model, the unit root test was repeated in the model with the intercept

$$\Delta r_t = a_0 + \delta r_{t-1} - \sum_{i=1}^{p} \gamma_i \Delta r_{t+1-i} + \varepsilon_t \quad . \quad (8)$$

Finally, in the case that the null hypothesis of the unit root was not rejected in the model with the intercept only, the unit root test was repeated in the model without intercept and trend.

[Table 4 here]

Table 4 presents the results of the ADF test on the REER series of West African currencies; the results indicate that those of Togo and Burkina Faso are stationary at the 5% critical level. As for Mali and Benin, the null hypothesis was not rejected at the 5% critical level but it is rejected at the 10% critical level. Therefore, for Togo and Burkina Faso, the PPP theory could hold, while it is very unlikely that the PPP theory holds for Mali and Benin.

6.2 Cointegration Analysis

[Table 5 here]

In the previous section, the ADF test for r_t series was used to demonstrate that the PPP theory does hold for some member countries of the WAEMU. For other countries, we tested the PPP theory from the perspective of the cointegration

between n_t and p_t. The cointegration test can be used to assess whether n_t and p_t maintain a stable long-term relationship (Johansen, 1988; Engle and Granger, 1987). The Engle-Granger procedure is effective for testing cointegration in a single equation, while Johansen's multivariate cointegration methodology should be used when there are more than two variables.

In this research, we estimated the cointegration regression using fully modified ordinary least squares (FMOLS) and tested the residuals from the viewpoint of stationarity (tau-statistic) as well as the autocorrelation coefficient (z-statistic); the residuals, u_t, were considered to be a p-th order autoregressive process (AR (p)) as follows:

$$\Delta \hat{u}_t = (\rho - 1)\hat{u}_{t-1} - \sum_{i=1}^{p} \zeta_i \Delta \hat{u}_{t-i} + \nu_t \,. \quad (9)$$

Table 5 presents the integrated order of both n_t and p_t, and the Engle–Granger tau-statistic and normalized autocorrelation coefficient (z-statistic) for the residuals were obtained from each series as dependant variables in a cointegrating regression. Côte d'Ivoire, Cape Verde, and Ghana were excluded from this cointegration analysis because n_t and/or $p_t \sim I(0)$. Lag length was determined based on the Schwarz Info Criterion. The null hypothesis is that the series are not cointegrated. The results show that both the statistics for Nigeria

reject this null hypothesis of no cointegration at the 15% level. As for Benin, the z-statistic rejects the null hypothesis at the 10.6% level, while the tau-statistics is slightly larger and rejects it at the 15.0% level.

7. Conclusion

We calculated the monthly REER, NEER, and ERPI for 13 West African countries for the period 1999–2008, using consumer prices and changing trade weights over time. Due to insufficient data availability and accuracy for these countries, we employed a method that is much simpler than the ones mentioned in section 2. We concentrated on calculating the above using an identical method and then comparing the results.

Contrary to our expectations, first, the values of the REER of WAEMU countries during the period 1999–2008 were found to have not appreciated substantially compared to the initial value, and they remained comparatively stable, albeit with some variation. It is somewhat surprising that the REER of WAEMU countries appreciated less than that of Nigeria, despite the strong appreciation of the euro in this period. This is a result of the fact that inflation in the WAEMU region has been fairly well controlled, although their NEERs grew stronger with the

appreciation of the euro. However, the REERs of WAEMU countries remained much stronger than those of the non-WAEMU countries, such as Ghana, the Gambia, and Guinea, whose NEERs continued to degrade substantially. This implies that the competitiveness of the exports of WAEMU countries has weakened in comparison to their neighbours who export similar products. At the same time, it indicates that WAEMU member countries can import foreign products more easily than their neighbouring countries. However, this fact also makes import-substitution production more difficult.

Second, from the viewpoint of variability as well as the coefficients of variation, the REERs of the countries whose currencies are pegged to the euro were more stable than those of their neighbouring countries. The NEERs of the latter group were devaluated to a greater extent, and the changes in their ERPIs were not sufficiently large to offset the changes in their NEERs (with the exception of Nigeria).

Third, the PPP theory tends to hold in those countries where the currencies are pegged to the euro rather than other countries that operate under a more flexible exchange rate regime. Exchange regimes in developing countries are increasingly attracting the attention of scholars and policy-makers, particularly

since the 1997–1998 Asian financial crisis. Furthermore, there is a plan for many African countries to cooperate to build a unique currency, the Afro, in the future. One of the concerns over this kind of currency union is that member countries will lose their access to an adjustment tool that can be used to offset external shocks. However, our research suggests that, in fact, countries that are members of the WAEMU seemed to respond better to external shocks than their non-WAEMU neighbouring countries, even though they cannot adjust their exchange rate. Moreover, this study implies that the establishment of WAMZ and its proposed integration with WAEMU will prove to be a challenging task predominantly because of the divergent movements of the member countries' REERs.

[Appendix here]

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[i] In French, the title is *Union Economique Monétaire Ouest Africaine.*

[ii] In French, the title is UMOA (*Union Monétaire Ouest Africaine*).

[iii] There is another CFA franc (Coopération Financière en Afrique Centrale), which is used in countries that were formally part of French Equatoriale Africa (Afrique-Équatoriale Française). In fact, this legal tender is managed by the Banques des Etats de l'Afrique Centrale (BEAC), and it is an entity distinct from the CFA franc issued by BCEAO, although they have been pegged to the French franc at an equal rate.

iv WAEMU was designed to help integrate the monetary union WAMU with an economic community named CEAO. CEAO was dissolved on 15 May 1994, immediately after the

creation of WAEMU, when it was hoped that WAMU might be integrated into WAEMU.

[v] http://www.oanda.com/convert/fxaverage.

[vi] For Cuba, we use the data of the indices of consumer prices (1999–2001) from Pauel Vidal Alejandro and Yaima Doimeadios, *Publicado en la Revista Economia y Dessarrollo*, Universidad de Habena, Edicion Especial 2003, and the data for 2002–2008 from the CIA World Fact Book.

[vii] CEMAC: Principal economic, financial and social indicators *1993–2006*. http://www.beac.int/stateco/depiefcemac.pdf. However, the data for 2005 has been estimated and that of 2006 is strictly a prevision.

[viii] With regard to exchange rate variability, there exist several types of measures: the effective variation as well as the variability of nominal and real effective exchange rates. See Lanyu, A. and E. C. Suss (1982) and Guillaumont Jeanneney, S. and J.-L. Parire (1991).

[ix] The CV is defined as the ratio of the standard deviation, σ, to the mean, μ, as follows:

$$CV = \frac{\sigma^2}{\mu}.$$

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Figures

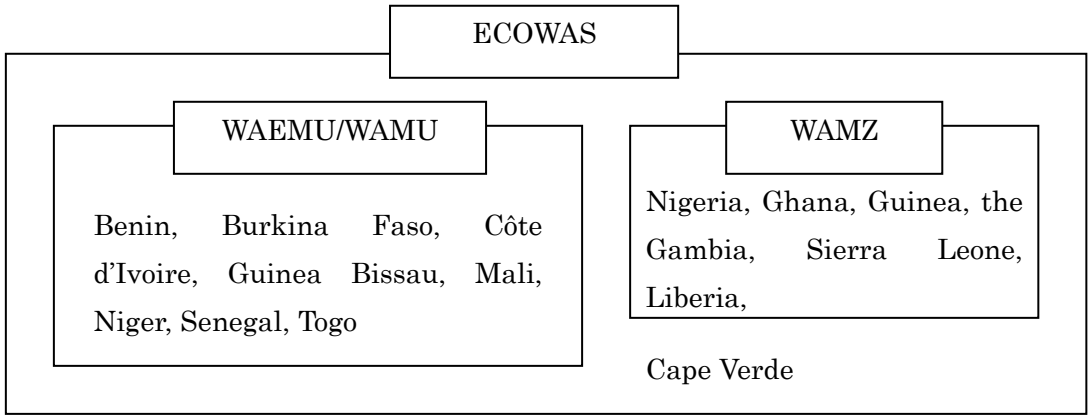


Figure 1: Two economic integrations and two monetary unions in West Africa (2010)

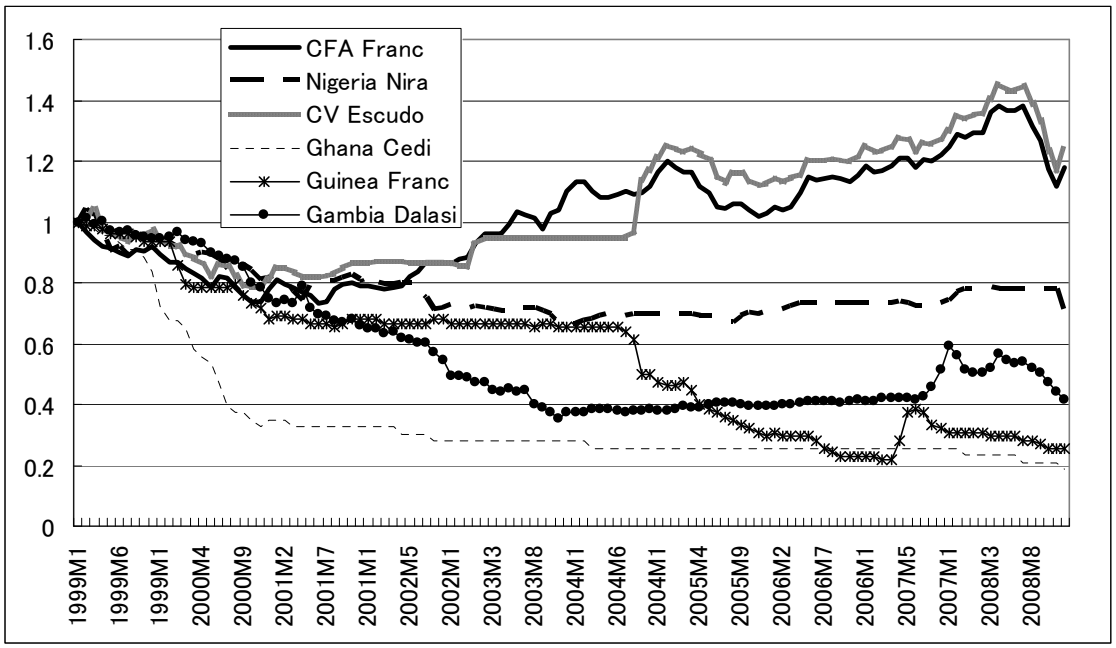


Figure 2. Value of the US dollar against each West African currency 1999–2008 (1999M1=1)

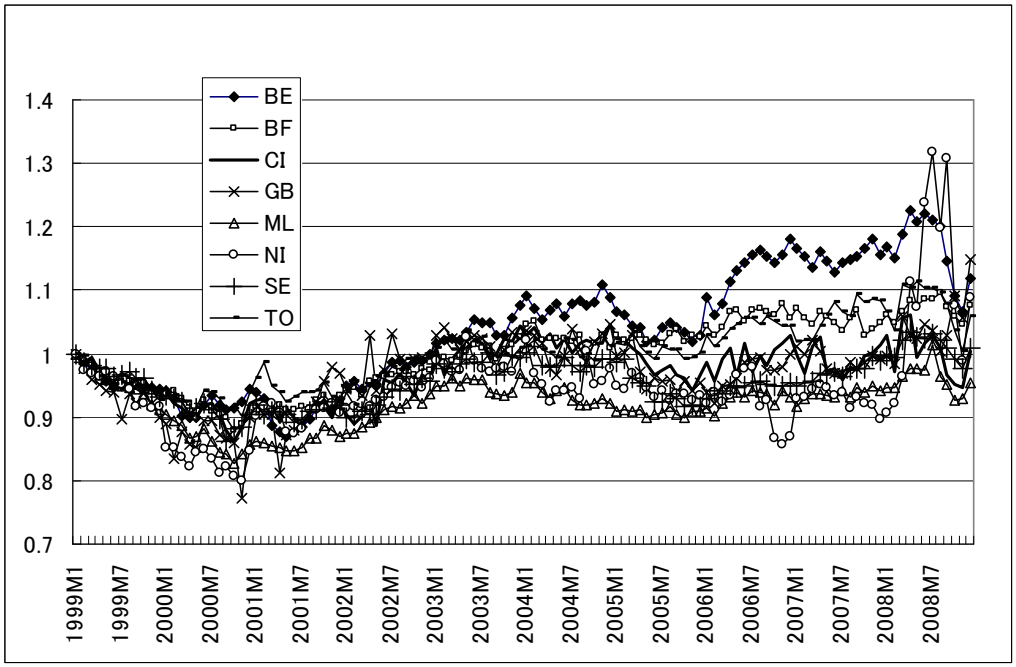


Figure 3 The REERs of WAEMU member countries

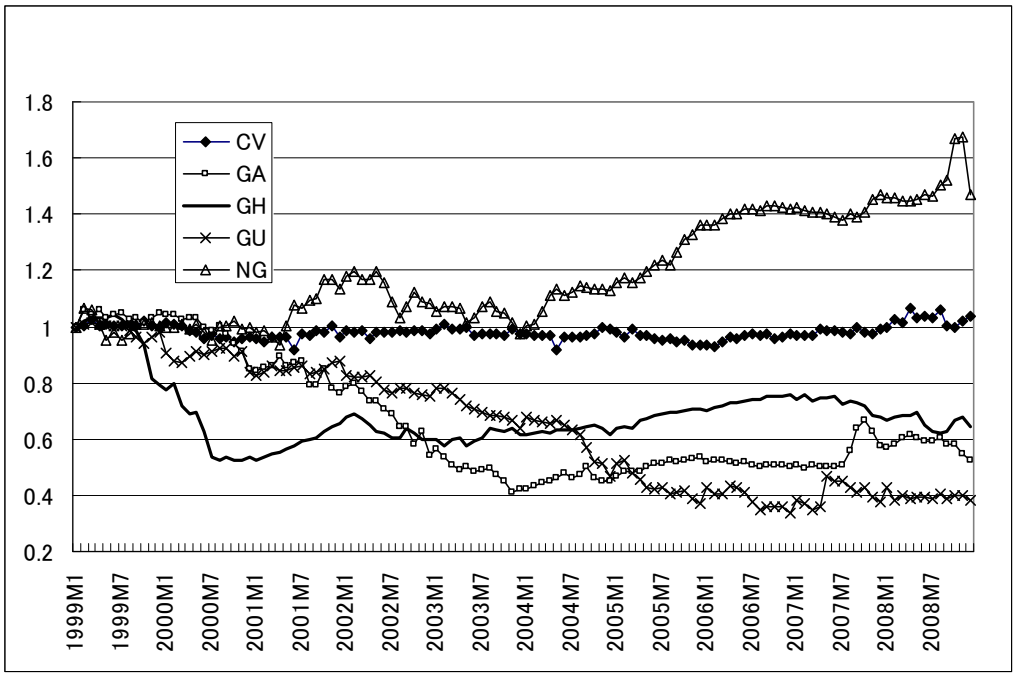
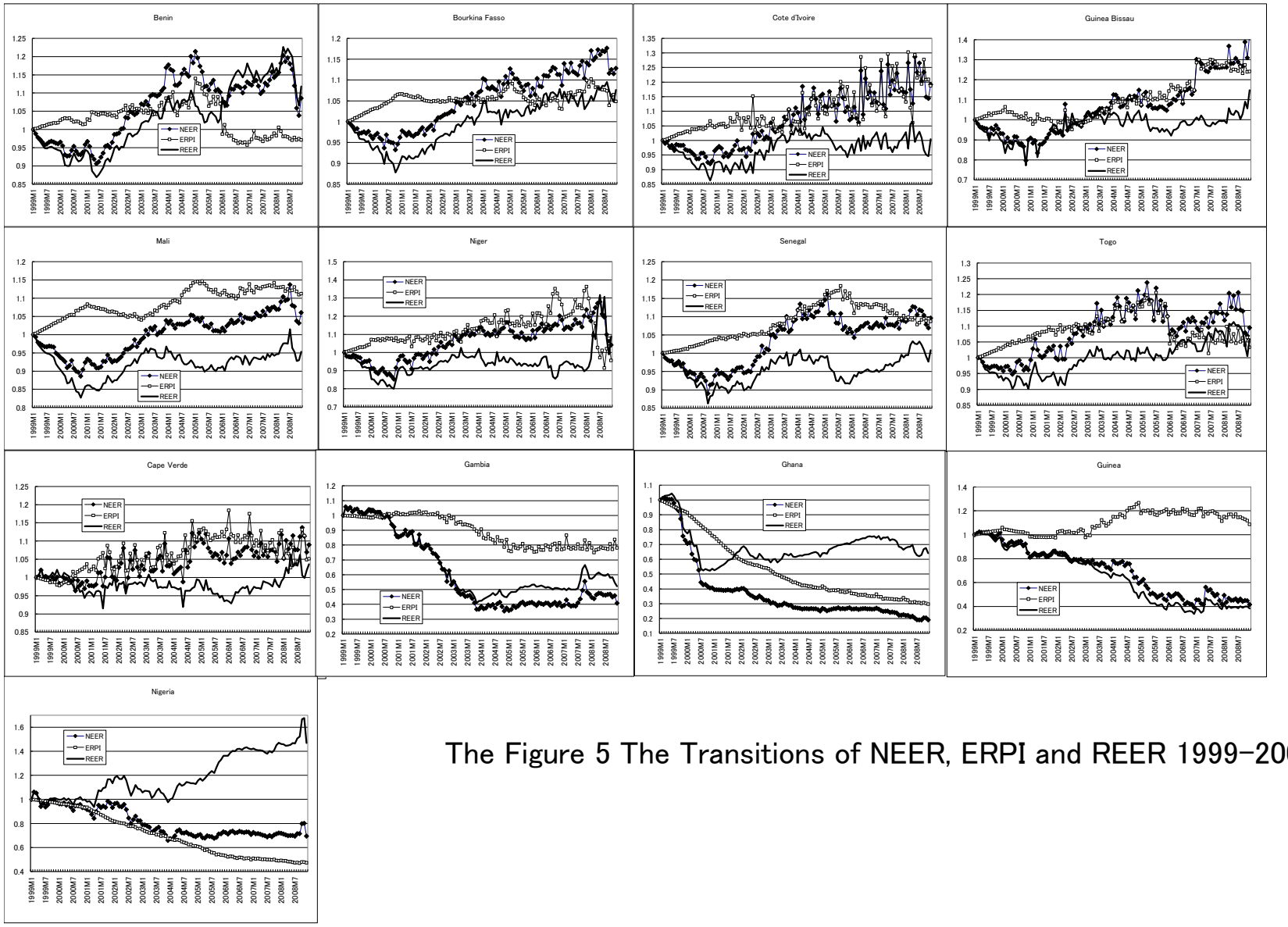


Figure 4 The REERs of WAMZ member countries



The Figure 5 The Transitions of NEER, ERPI and REER 1999-2008

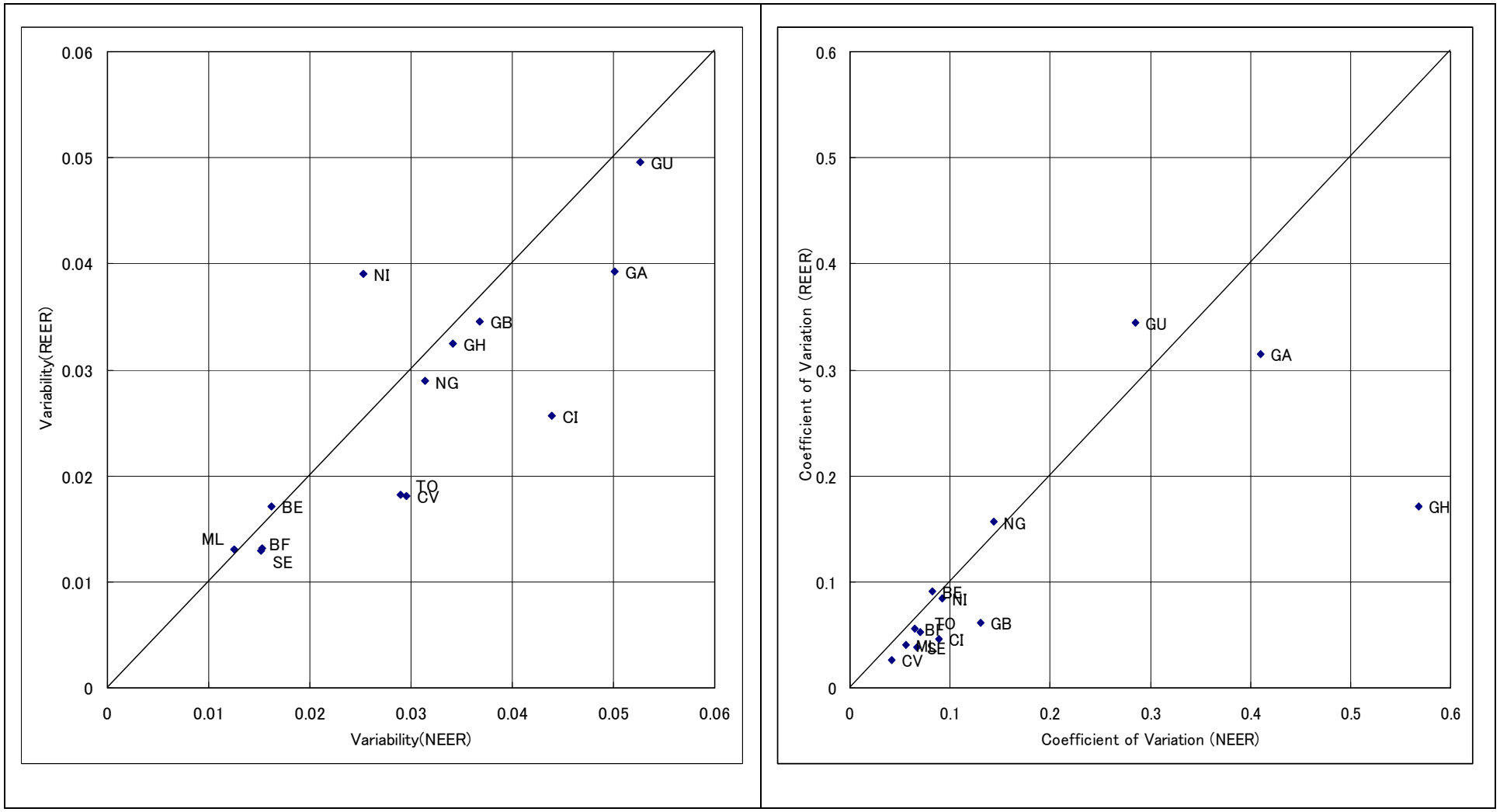


Figure 6　The relationship between the REER and the NEER of both the variability and the CV.

Table 1: Member countries of euro/CFA zone

Area	Member countries
Euro (12)	Belgium, Germany, Greece*, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, and Finland
WAEMU (8)	Burkina Faso, Benin, Cote d'Ivoire, Niger, Mali, Senegal, Togo, and Guinea Bissau
CEMAC (4)	Chad, Congo Republic, Republic of Central Africa, Gabon, Cameroon, and Equatorial Guinea

*Greece was admitted into the Euro Accession in 2001. However, for simplicity, we treat this country as if it had been a member of the euro area since 1999.

Table 2 Descritive Statistics of REER and NEER

Number of Observations 120

	BE	BF	CI	GB	ML	NI	SE	TO	CV	GA	GU	NG	GH
Mean(NEER) (a)	1.064	1.053	1.072	1.064	1.000	1.063	1.036	1.083	1.042	0.607	0.696	0.805	0.376
Mean(REER) (b)	1.036	0.999	0.972	0.969	0.920	0.946	0.956	0.999	0.981	0.664	0.647	1.189	0.686
(a)-(b)	0.028	0.054	0.100	0.095	0.080	0.117	0.081	0.084	0.062	-0.057	0.049	-0.384	-0.311
Coefficients of Variation(NEER) (c)	0.082	0.065	0.089	0.131	0.056	0.092	0.067	0.070	0.041	0.411	0.286	0.144	0.568
Coefficients of Variation(REER) (d)	0.091	0.056	0.047	0.061	0.041	0.085	0.039	0.053	0.027	0.315	0.345	0.157	0.171
(c)-(d)	-0.009	0.008	0.042	0.070	0.016	0.007	0.028	0.017	0.015	0.096	-0.059	-0.013	0.397
Variability (NEER) (e)	0.016	0.015	0.044	0.037	0.013	0.025	0.015	0.029	0.030	0.050	0.053	0.031	0.034
Variability (REER) (f)	0.017	0.013	0.026	0.035	0.013	0.039	0.013	0.018	0.018	0.039	0.050	0.029	0.032
(e)-(f)	-0.001	0.002	0.018	0.002	-0.001	-0.014	0.002	0.011	0.011	0.011	0.003	0.002	0.002

Table 3 Characteristics of the variation in the REERs

		Coefficient of variation (REER)		
		Low (<0.1)	Middle (0.1–0.3)	High (>0.3)
Variability (REER)	Low (<0.02)	ML, BE, BF, SE TO,CV		
	Middle (0.02–0.04)	NI, GB, CI,	GH, NG	GA
	High (>0.04)			GU

Table 4 ADF test results for r_t

	Level		First difference	
	Intercept & trend	Intercept	Intercept & trend	Intercept
Benin	-3.407785(1)*	-0.859891(0)	-8.626140(0)***	-8.658991(0)***
Burkina Faso	-3.720494(0)**	-0.568579(1)	-13.86873(0)***	-13.82508(0)***
Côte d'Ivoire	-2.978583(1)	-2.135612(1)	-10.48459(1)***	-10.52416(1)***
Guinea Bissau	-2.933542(1)	-1.534737(1)	-10.59965(1)***	-10.51765(1)***
Mali	-3.233943(0)*	-2.273008(0)	-11.47065(0)***	-11.32700(0)***
Niger	-2.977586(4)	-2.020428(4)	-6.586162(3)***	-6.497964(3)***
Senegal	-2.783756(0)	-1.769712(0)	-11.73755(0)***	-11.66115(0)***
Togo	-4.658193(0)***	-1.734455(0)	-11.80829(0)***	-11.84123(0)***
Cape Verde	-2.156863(1)	-2.131286(1)	-17.75508(0)***	-17.71073(0)***
Nigeria	-2.585389(2)	-0.346953(2)	-8.607017(1)***	-8.619352(1)***
Ghana	-2.725130(1)	-2.805713(1)	-8.022573(0)***	-7.897919(0)***
Guinea	-2.458244(0)	-0.829940(0)	-12.36087(0)***	-12.41100(0)***
The Gambia	-0.907459(0)	-1.397211(0)	-10.81054(0)***	-10.69452(0)***

Note: The values in parentheses indicate the lag difference. The lag difference was determined using the Schwarz Info Criterion. The notations ***, **, and * indicate the rejection of the null hypothesis of the unit root at critical levels 1%, 5%, and 10%, respectively.

Table 5 Results of the Engle-Granger co-integration test

	Integrated order of n_t	Integrated order of p_t	Lag difference	tau statistic	p-value	z statistic	p-value
Benin	1	1	1	-3.339	0.155*	-21.771	0.106**
Côte d'Ivoire	0	0	-	-	-	-	-
Guinea Bissau	1	1	1	-1.357	0.536	-6.085	0.377
Mali	1	1	0	-2.430	0.316	-8.469	0.450
Niger	1	1	4	-1.333	0.548	-4.918	0.471
Senegal	1	1	0	-2.123	0.467	-8.177	0.471
Cape Verde	0	1	-	-	-	-	-
Nigeria	1	1	0	-2.303	0.140**	-10.464	0.149**
Ghana	0	0	1	-	-	-	-
Guinea	1	1	1	-1.357	0.536	-6.085	0.377
The Gambia	1	1	2	-0.929	0.731	-1.783	0.786

Note: The lag difference was determined according to the Schwarz Info Criterion. **and *indicate the rejection of the null hypothesis of a unit root at the critical levels 15% and 20%, respectively.

tau statistic= $\frac{\hat{\rho}-1}{se(\hat{\rho})}$, z- statistic= $\frac{T(\hat{\rho}-1)}{1-\sum_j \hat{\delta}_j}$

Appendix I: Trade Share (1999-2008 Average)

	EURO	WAEMU	CEMAC	1	2	3	4	5	6	7	8	9	10	TOTAL	ROW
BE				China	USA	Thailand	Malaysia	Ghana	UK	Nigeria	India	Indonesia	Singapore		
	21.03%	7.69%	0.62%	30.87%	6.68%	5.45%	2.80%	2.73%	2.20%	2.14%	2.07%	1.68%	1.16%	87.10%	12.90%
BF				China	Singapore	Ghana	Libya	India	USA	Thailand	Japan	Morocco	Indonesia		
	31.76%	27.17%	0.02%	6.88%	3.63%	2.48%	2.47%	2.15%	1.71%	1.71%	1.34%	1.24%	0.85%	83.40%	16.60%
CI				Nigeria	USA	UK	China	India	Ghana	Russia	Thailand	Brazil	Poland		
	38.58%	7.41%	1.97%	14.04%	6.73%	2.49%	2.31%	1.67%	1.62%	1.53%	1.23%	1.04%	0.84%	81.47%	18.53%
GB				India	Brazil	Nigeria	Uruguay	Thailand	China	USA	Cuba	Pakistan	UK		
	21.80%	11.18%	0.05%	24.10%	14.05%	4.45%	3.46%	3.20%	2.15%	1.70%	1.67%	1.58%	0.50%	89.91%	10.09%
ML				China	SA	India	USA	Thailand	UK	Morocco	China	Czech	Brazil		
	24.59%	20.96%	0.02%	5.16%	2.41%	1.93%	1.90%	1.44%	1.16%	0.93%	0.88%	0.72%	0.64%	62.73%	37.27%
NI				Japan	Nigeria	USA	China	Pakistan	India	Ghana	UK	Switzerland	Russia		
	28.37%	9.91%	0.11%	14.09%	11.63%	6.74%	4.70%	4.22%	3.64%	1.71%	1.69%	1.54%	0.94%	89.29%	10.71%
SE				Nigeria	India	UK	Thailand	China	USA	Brazil	Japan	Gambia,	Morocco		
	39.12%	8.93%	1.90%	5.11%	4.68%	4.52%	3.90%	3.74%	2.67%	2.08%	1.68%	1.32%	1.12%	80.77%	19.23%
TO				China	Ghana	USA	Estonia	UK	Thailand	Malaysia	India	Indonesia	Brazil		
	25.60%	12.31%	0.73%	22.58%	4.48%	3.76%	3.02%	2.90%	2.32%	2.11%	1.57%	1.42%	1.32%	84.11%	15.89%
CV				Brazil	USA	UK	Algeria	China	Japan	Turkey	T&T	Thailand	Vietnam		
	71.25%	3.54%	0.46%	3.76%	3.35%	2.99%	2.68%	1.25%	1.19%	1.15%	0.54%	0.45%	0.40%	93.01%	6.99%
GA				Brazil	UK	India	USA	Malaysia	China	Thailand	Turkey	Morocco	Japan		
	18.52%	16.11%	0.32%	6.36%	5.72%	4.56%	3.46%	2.51%	2.17%	1.87%	1.73%	1.41%	1.29%	66.05%	33.95%
GH				Nigeria	China	UK	USA	India	SA	Brazil	Japan	Thailand	Malaysia		
	26.56%	5.17%	0.72%	10.64%	8.84%	7.26%	6.45%	3.08%	2.78%	2.30%	2.17%	1.54%	1.43%	78.93%	21.07%
GU				China	USA	Russia	Ukraine	Korea	UK	India	Swiss	SA	Canada		
	31.29%	4.91%	0.91%	6.01%	5.81%	4.21%	3.31%	2.98%	2.57%	2.26%	1.21%	1.20%	1.19%	67.87%	32.13%
NG				USA	Brazil	China	India	UK	Korea	SA	Japan	Indonesia	Ghana		
	23.19%	3.18%	0.86%	32.36%	6.15%	4.20%	3.58%	3.15%	2.15%	2.12%	1.93%	1.35%	1.29%	85.49%	14.51%

SA: South Africa , T&T: Trinidad &Tobago, Swiss : Switzerland