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Cécile Couharde
Carl Grekou
Valérie Mignon

EconomiX - UMR7235
Université Paris Nanterre
Bâtiment G - Maurice Allais, 200, Avenue de la République
92001 Nanterre cedex

Email : secretariat@economix.fr

On the desirability of the West African monetary union

Cécile Couharde [*] Carl Grekou [†] Valérie Mignon [‡]

Abstract

In this paper, we investigate from a policy coordination viewpoint the desirability of the West African monetary union project, *ECO*. Our approach is built around the inclusion of national objectives in the regional integration perspective. Thanks to cluster analysis, we identify two groups of countries with relatively homogenous sustainable exchange rate paths in West Africa. We also find that no single currency peg nor a freely floating exchange rate regime would be preferable for any of the countries or groups of economies. Overall, our findings argue in favor of two *ECOs* —at least in a first step, i.e. one for each of the two identified zones. Each *ECO* would serve as a virtual anchor —with some flexibility— for the considered group, and would be determined by a basket of currencies mainly composed of euro and US dollar.

JEL Classification: F33, F45, C38, O55.

Keywords: Monetary integration; West Africa; CFA franc zone; ECOWAS.

[*]EconomiX-CNRS, University of Paris Nanterre, France. E-mail: cécile.couharde@parisnanterre.fr

[†]CEPII and EconomiX-CNRS, University of Paris Nanterre, France. E-mail: carl.grekou@cepii.fr

[‡]EconomiX-CNRS, University of Paris Nanterre, and CEPII, France. Email: valerie.mignon@parisnanterre.fr.

1 Introduction

During the year 2019, the longstanding monetary union project of the Economic Community of West African States (ECOWAS) has undergone a considerable acceleration. This surge, mainly influenced by the popular rejection of the CFA franc —a currency shared by eight countries from the zone since 1945 (the West African Economic and Monetary Union, WAEMU thereafter)— reaches its peak on June 29^{th} in Abuja during the 55^{th} ordinary session of the ECOWAS Conference of Heads of State and Government where the latter agreed to launch a new currency, the "*ECO*" by 2020.[1] However, given the difficulties for the *ECO* to be implemented, the roadmap foresees a gradual approach based upon the achievement of the required ten convergence criteria. On December 21^{st} of the same year, as expected, the president of Côte d'Ivoire, on behalf of his counterparts from the WAEMU, announced that (*i*) the *ECO* would be adopted first by the WAEMU countries, and (*ii*) the latter will maintain the fixed parity with the euro inherited from the CFA franc. The fixed parity *vis-à-vis* the euro is the main criticism addressed to the CFA franc and is contrary to the currency basket peg retained for the *ECO* in its ECOWAS design. Inexorably, if the ECOWAS monetary union comes to exit one day, the different countries would have to agree on a basket of currencies. This paper tackles this issue and aims at studying the desirability of the *ECO* project.

More specifically, building on the approach developed by Coudert et al. (2019), we investigate, from a policy coordination viewpoint, the sustainability of the *ECO* in its various forms —that can also be seen as the different steps towards the ECOWAS monetary union. The key take-away from Coudert et al. (2019) is the following: since the main cost associated with participation in a monetary union is the loss of the monetary policy autonomy, a country would be more likely —or less armed— to join a monetary union if its "optimal" or sustainable exchange rate path coincides with that of the other members. Adopting such an approach presents several benefits.

First, in currency unions, the least advanced economies generally endure the common monetary policy which, either imposed by the leading countries or resulting from an unfortunate combination of circumstances, rarely fits with the economic structures and, in turn, the national "needs". Are the member states willing to subordinate national interests to regional interests? Is Nigeria —accounting for two-thirds of the zone's GDP and broadly half of the population— willing to renounce its monetary policy autonomy? Is the naira affordable as an anchor by the other countries? Given the logical negative answers

[1] The WAEMU is composed of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. The ECOWAS is formed by the WAEMU countries, Cabo Verde, Gambia, Ghana, Guinea, Liberia, Nigeria, and Sierra Leone.

expected to these crucial questions, the only window of opportunity for the feasibility and sustainability of such a monetary union is that of the compatibility of the "optimal" or sustainable national monetary policies.

The rather recent experiments within the euro area have stressed the importance of the adequacy between the member states' sustainable exchange rate paths. Indeed, the mismatch between the core and periphery countries regarding the exchange rate level has led to the building-up of large macroeconomic imbalances disguised in catching-up phenomena. Given the loss of the exchange rate as an adjustment tool, countries were forced to adjust *via* internal devaluations, which, in addition to being socially costly and lengthy processes, undermined the growth momentum. This was particularly the case in Greece. However, the difficulties were not restricted to the countries undergoing economic hardships but spread to the others, even the healthier ones, challenging the union's perennation—despite good institutions, lifting up country spreads that further widen the gaps between the countries hence feeding a vicious circle.

Second, as detailed below, we define the "optimal" or "sustainable" exchange rate path as the exchange rate level underlying the equilibrium exchange rate. The latter is defined in the literature as the exchange rate allowing simultaneously both internal and external balances —which are central for a stable and sustained economic development (Alberola et al., 1999; Berg and Miao, 2010; Schröder, 2013), and maximizing welfare (Engel, 2011). Our approach therefore fully accounts for the countries' economic and structural characteristics as well as their interdependencies, and addresses the issue of sustainability at both the country and the monetary union levels simultaneously.

Third, by focusing on a unique but all-encompassing policy indicator, our approach allows us to avoid the problem of inconclusiveness associated with the traditional Optimum Currency Area (OCA) theory framework due to the consideration of several macroeconomic variables. Overall, we can gather in a unified framework different aspects of monetary union viability, and identify the "natural" member countries.

To this end, we rely on a two-step methodology. First, we use the Hierarchical Ascendant Classification (HAC) method and factor analysis, and identify two groups of countries with relatively similar sustainable exchange rate paths. The first group is formed of the WAEMU countries —Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo— and Cabo Verde. The second one is made of Gambia, Ghana, Guinea, Nigeria, and Sierra Leone. Liberia, although belonging to this second set of countries, is an outlier. In a second step, we address the sustainable exchange rate regime (ERR) issue —i.e., the regime underlying the sustainable exchange rate path— by inferring the weights associated with hypothetical basket pegs. Our findings show that no single currency peg

nor a freely floating ERR would be desirable for any of the considered countries. Instead, we suggest that a basket peg with a certain degree of flexibility would be preferable. Overall, our results tilt in favor of the *ECO* as a common —but not unique— currency, and the necessity of two distinct *ECO* zones in a first phase. Within each zone, countries would peg —with some flexibility— their national currency to the *ECO*, which itself would be defined by the consistent currencies' basket. Due to differences regarding the adjustment capacities, this first stage of the implementation of the *ECO* should be long enough to ensure both nominal and real convergence before proceeding further. In this sense, we go further than previous studies by showing that countries' heterogeneity is not an insurmountable obstacle for their integration desire.

The rest of the paper is organized as follows. Section 2 provides some background elements regarding the ECOWAS countries and a review of the related literature. Section 3 is devoted to the methodology and data. In Section 4, we focus on heterogeneity between ECOWAS countries, and present the results of HAC and factor analysis. Section 5 reports our findings related to the ERR choice. Finally, Section 6 concludes.

2 Background

The developments regarding the *ECO* during 2019 took place against a —a priori— favorable background marked by considerable GDP growth rates. Indeed, as can be seen in the top left panel of Figure 1, the average GDP growth rate of the ECOWAS over the 2014-2018 period is equal to 4.4%. The WAEMU countries display higher growth rates —around 6% on average— with Côte d'Ivoire showing the highest one (8.15%). In the non-WAEMU countries, the picture is less homogeneous with, on the one hand, Ghana and Guinea exhibiting high GDP growth rates comparable to WAEMU countries, and, on the other hand, Sierra Leone displaying a negative growth rate. On its part, Nigeria registered an average GDP growth rate of 2% over the same period. This value is well below the 6% rate recorded during the first half of the decade.

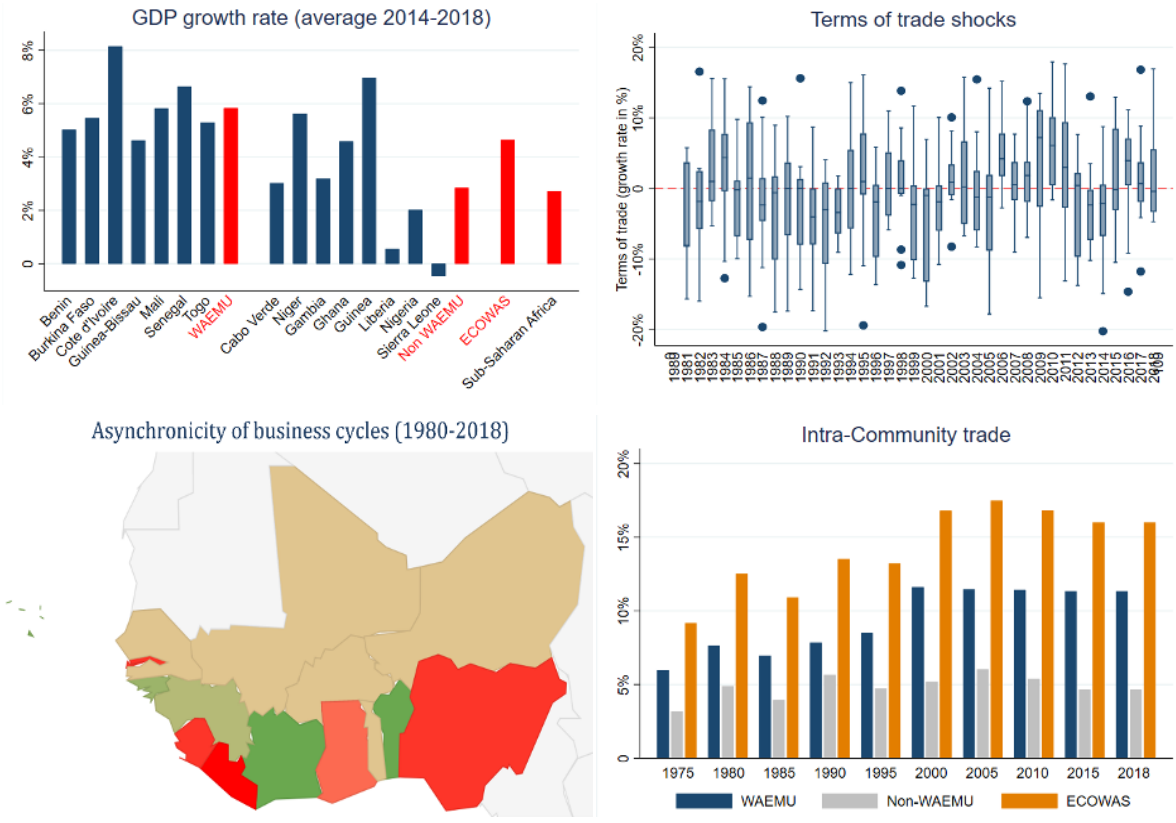

Figure 1 — Favourable context despite structural headwinds

Note: Data on GDP growth rates and terms of trade are from the *World Development Indicators* database (World Bank). The bottom left map is based on the results from a clustering method (Hierarchical Ascendant Classification) implemented by the authors. The input data are the output gaps derived by applying the Hodrick-Prescott filter to GDP (*World Economic Outlook*, IMF) over the 1980-2018 period. Statistics on intra-community trade flows are from the *EQCHANGE* database (CEPII).

The case of Nigeria is very interesting because it illustrates some structural weaknesses

characterizing these countries, namely their strong dependence on commodities and, in turn, on terms of trade shocks.[2] Furthermore, this strong dependency on commodities coupled with a very low diversification of their exports, exposes these countries to a sequence of different and considerable terms of trade shocks —see the latters's dispersion in the top-right chart of Figure 1. One consequence is the asynchronicity of business cycles in the zone. As the bottom-left chart of Figure 1 shows, we can broadly distinguish three groups of countries with more or less synchronicity of the cycles. However, this asynchronicity also reflects the weakness of endogenous growth factors as the intra-community trade (bottom-right chart of Figure 1). In almost half-century of its existence, intra-ECOWAS trade had increased from 9% in 1975 to 16% in 2018. Intra-WAEMU trade, around 6% in 1975, is now about 12%. For the non-WAEMU countries, the trade flows have barely gained two percentage points. This weak level of trade integration is again explained by the specialization of these economies in commodities, and, most importantly, by the near absence of industries —and, in turn, of real wealth creation. As displayed in Table 1, the manufacturing value added (as a share of GDP) is, on average, around 8.4% in the ECOWAS over the 2010-2018 period, average pulled up by the WAEMU zone.

Table 1 — Some indicators (average 2010-2018)

	ECOWAS	WAEMU	Non WAEMU
Manufacturing, value added (% GDP)	8.4	10.5	6.3
Foreign direct investment, net inflows (% GDP) [a]	4.4	3.3	5.9
Domestic credit provided by financial sector (% GDP) [b]	26.2	27.2	24.4
Lending interest rate (%) [c]	9.9	5.2	17.6
Inflation, consumer prices (annual %)	4.9	1.4	8.9
Revenue, excluding grants (% GDP) [d]	18.4	19.6	17.3
Tax revenue (% GDP) [d]	15.1	15.8	14.3
Population growth (annual %)	2.6	2.9	2.4
Age dependency ratio (% of working-age population)	86.0	91.1	80.2

Source: *World Development Indicators* (World Bank)
"*a*": Liberia=43%; "*b*": Cabo Verde = 83%; Liberia = 850%; "*c*": Missing data: Ghana, Guinea; "*d*": Missing data: Côte d'Ivoire, Ghana, Mali, Togo.

Overall, while many economies are in rapid expansion, the nature of this expansion is not satisfactory to meet the structural challenges these economies are facing. Among these challenges, funding is key since these countries attract very few capitals: the foreign direct investment net inflows are evaluated at 4.4% of the GDP in the ECOWAS, and only 3.3% on average for the WAEMU; the banking conditions are not favorable with high interest rates. On their part, the governments have very little room given that their

[2]The fall in the price of oil in 2014 has significantly impacted Nigeria, and resulted in a considerable decrease in the growth prospects.

revenues are, on average, around 20% of the GDP, with an average rate of fiscal pressure amounting to 15%. This picture has to be completed by the demographic context —again marked by significant growth rates and relatively high age dependency ratios— and the Sahel band countries' security situation.

In light of these characteristics, one may question the desirability of the monetary union —as well as the reasons behind the acceleration of this project— given the important structural differences and weaknesses. These concerns are even more legitimate given that the countries do not satisfy the *ex ante* conditions for the viability of a monetary union, as specified by the Optimum Currency Area (OCA) theory.

The OCA theory, initially developed by Mundell (1961) —and extended by McKinnon (1963) and Kenen (1969)— generally serves as a frame of reference for analyzing the implications related to participation in a monetary union. This literature suggests that two economies have an interest in sharing the same monetary policy (i.e., a peg or a common currency) if and only if the shocks they face are symmetrical. However, if the shocks are asymmetrical, Mundell suggests that the loss of the exchange rate as an adjustment tool is less serious if alternative mechanisms are available —e.g., price and wage flexibility, labor mobility, fiscal transfers. Following Mundell (1961), McKinnon (1963) puts forward the importance of regional trade integration (the trade openness of each country vis-à-vis the other member countries), and argued that the more these economies trade with each other, the higher the interest in stabilizing the exchange rates. Later on, Kenen (1969) emphasized the importance of diversification to mitigate the effects of specific shocks.[3]

Hence, based on the OCA theory, the West African countries do not satisfy the *ex ante* conditions for the "optimality" of a monetary union and, therefore, should not form one —especially since they do not meet the convergence criteria they agreed on (see Figure A.1 in Appendix A).

This conclusion is also shared by several empirical studies focusing on the West African monetary union project that put forward the heterogeneity of countries as well as that of the shocks they face as the major impediments. Bénassy-Quéré and Coupet (2005), using a set of variables stemming from the OCA theory —and from the "*fear of floating*" literature (see Calvo and Reinhart, 2002)— rely on cluster analysis to investigate the monetary arrangements in 17 Central and West African countries. Their results indicate

[3]Fleming (1962) and Mundell (1963) (thereafter, Mundell-Fleming) also enriched the debate by showing that a fixed ERR should be preferably chosen by small open economies whose trade is more concentrated with member countries —in this case, trade and welfare gains are maximized thanks to lower exchange rate variability— while for countries with a higher incidence of real shocks, adopting flexible ERR is a better choice.

that, although the creation of a monetary union including Nigeria is not economically viable, a union with the "core" of the WAEMU and Ghana, Gambia, and Sierra Leone can be relevant. Tsangarides and Qureshi (2008) also rely on cluster analysis to investigate the homogeneity of the potential members in terms of economic characteristics inspired by the OCA literature and the convergence criteria set by these countries. They show that countries belonging to WAEMU and WAMZ (West African Monetary Zone; i.e., non-WAEMU ECOWAS countries) do not form a homogenous group. Mobilizing the same methodology, Coulibaly and Gnimassoun (2013) focus on the convergence and co-movements between West African countries' exchange rate misalignments. Their results show that the WAEMU area has a core composed of Burkina Faso, Mali, Niger, and Senegal, which can be joined by Ghana, Sierra Leone, and the Gambia. Bangaké (2008) focuses on the relationship between bilateral exchange rates and some OCA criteria variables. In line with those of Bénassy-Quéré and Coupet (2005) and Coulibaly and Gnimassoun (2013), his results indicate the existence of a core of the WAEMU to which Ghana could be linked. He also underlines that Nigeria should not be part of the WAMZ as well as the WAEMU. Houssa (2008), using a dynamic factor model, shows that supply shocks in the ECOWAS are more important than demand shocks. He finds a positive correlation of demand shocks —with a temporary effect on output— and significant asymmetry regarding supply shocks. As a result, he concludes that a monetary union would be costly. Chuku (2012), by testing for symmetry and speed of adjustment to supply, demand, monetary and real exchange rate shocks, reaches the same conclusion: almost 85 percent of correlations in supply, demand, and monetary shocks among the countries are asymmetric. Finally, Dufrénot and Sugimoto (2013) show that the ECOWAS would not agree on the same anchor currency because of the heterogeneity of member countries and the "incompatibility" of objectives (e.g., internal and external competitiveness).

However, the OCA theory is challenged in the literature by the theory of the endogeneity of monetary unions advanced by Frankel and Rose (1998). According to the latter, if the OCA theory conditions are not satisfied *ex ante*, the participation in the monetary union and the subsequent increase in the intra-community trade will (rein)force *ex post* the synchronicity of the business cycles. In other words, the cost of the monetary union would be decreasing over time.[4] This point of view is shared by Ouédraogo (2003), Diop (2007), and Tapsoba (2009).

[4]Note, however, that Krugman (1993) does not share this point of view. According to him, if a monetary union leads to an intensification of trade between the member countries, it will also lead *in fine* to a desynchronization of the economies because of a specialization of these latter due to their comparative advantages.

Beyond the apparent divergences, these different theories can be seen as complementary in that they all stress key points for the viability of a monetary union. They all agree that the benefits from a monetary union would transit through the intensification of trade. Hence, regardless of its geographical frontiers, the viability of the *ECO* zone is conditioned by the development of regional trade —which is paradoxical because the issue of the exchange rate regime relegates itself in second place. At the forefront are questions related to sustainable and inclusive growth/development. But, in this matter, if the benefits can be expected mainly —not to say only— through trade, one may question whether the monetary union would leave sufficient room to the member countries —in terms of funding— to initiate an industrialization process that is necessary to boost intra-community trade. This question is also accurate for the financing needs to face the structural challenges (e.g., sustainable development goals). Say differently, one may wonder whether it is not too soon for establishing a fixed exchange rate between the countries given the associated constraints in terms of fiscal space or of adjustments to macroeconomic imbalances that would inevitably result from catching-up effects. Our approach also falls within this scope and is articulated around the inclusion of national objectives (needs) from the perspective of regional integration. Our framework's central point is the long-run sustainability appreciated here by the macroeconomic equilibria and proxied by the equilibrium exchange rates.[5]

3 Methodology and data

3.1 Methodology

As stated above, our approach focuses on the inclusion of national objectives from the perspective of regional integration. Therefore, it aims to identify groups of countries for which (*i*) the coordination of national policies is possible/desirable, and (*ii*) regional integration would be done at minimal cost while ensuring the consistency of the unique monetary policy. The latter is guaranteed by the identification of groups of countries sharing similarities in their equilibrium exchange rates' dynamics. Indeed, since the main cost associated with participation in a monetary union is the loss of the monetary policy autonomy, a country would be more likely —or less armed— to join a monetary union if its "optimal" or sustainable exchange rate path coincides with that of the other members.

[5]Recall that the equilibrium exchange rate is defined as the value of the exchange rate allowing the economy to reach both the internal and external balances.

We follow Coudert et al. (2019) and implement a cluster analysis based on the Hierarchical Ascendant Classification (HAC) method. This technique allows us to partition the ECOWAS area into relatively homogeneous groups of nations without imposing any reference group or leading country. The HAC method also provides information on the degree of heterogeneity in the zone, by evidencing interrelationships within and between the different groups of economies.

Formally, the HAC procedure begins by estimating the dissimilarities between any pair of objects (here the dissimilarities between the sustainable exchange rate paths for any pair of countries) using an appropriate metric (i.e., a measure of the distance between pairs of objects), such as the Euclidian distance. Let $X_{i,t}$ be the sustainable exchange rate for country i at period t ($t = T_1, \ldots, T_N$), the dissimilarity coefficient defined by the Euclidean distance between the sustainable exchange rate of country i and country j is:

$$d(X_i, X_j) = \sqrt{\sum_{t=T_1}^{T_N} \left(X_{i,t} - X_{j,t}\right)^2} \tag{1}$$

Using distance information, pairs of objects are then grouped into clusters that are further linked to other objects to create bigger clusters. The agglomeration is based on a metric measuring the distance between two clusters. For the sake of robustness, we retain four agglomerative methods: (i) Ward's linkage, (ii) the single-linkage, (iii) the complete-linkage, and (iv) the average-linkage.[6]

Let A and B be two clusters with, respectively, n_A and n_B as the number of objects, and $\overline{A}$ and $\overline{B}$ as the centroids. The following formulas give the different inter-cluster distances computed by the various hierarchical algorithms:

Ward's method:

$$d(A, B) = \frac{2n_A n_B}{(n_A + n_B)}\, d\big(\overline{X}_A - \overline{X}_B\big)^2 \tag{2}$$

Single-linkage:

$$d(A, B) = min\left(d\big(X_{Ai}, X_{Bj}\big)\right) \tag{3}$$

Complete-linkage:

$$d(A, B) = max\left(d\big(X_{Ai}, X_{Bj}\big)\right) \tag{4}$$

[6]The Ward's method consists in joining two clusters that result in the minimum increase in the sum of squared errors (so the loss of within-cluster inertia is minimum). The single-linkage —or "*nearest neighbor*"— focuses on the smallest distance between objects in the two clusters. The complete —or "furthest neighbor"— concentrates on the largest distance between objects in two clusters. Finally, the average-linkage method uses the average distance between all pairs of objects in any two clusters. For more details regarding these measures, see Kaufman and Rousseeuw (1990).

Average-linkage:

$$d(A,B) = \frac{1}{n_A n_B} \sum_{i=1}^{n_A} \sum_{j=1}^{n_B} d\big(X_{Ai}, X_{Bj}\big) \tag{5}$$

where $i = 1, \ldots, n_A$ (resp. $j = 1, \ldots, n_B$) designates the i^{th} (resp. j^{th}) object in cluster A (resp. B).

An additional issue associated with the *ECO* project is the choice of the exchange rate regimes (ERR). Indeed, while the determination of the different groups of economies fits more into the regional integration dimension of the project, that of the various countries' ERR plays a key role in their adjustment capacities towards their equilibrium exchange rates. To infer the nature of the ERR underlying the equilibrium exchange rates, we follow the approach commonly used in the literature to identify *de facto* regimes (see Frankel and Wei, 1994, 2008). This method is based on the estimation of hypothetical weights of different potential anchor currencies. More specifically, it consists of regressing the dependent variable —the exchange rate in the case of the determination of the ERR— on a set of major currencies, with the constraint that all the coefficients associated with the currencies sum to one.

In our exercise, the dependent variable is the bilateral exchange rate *vis-à-vis* the Special Drawing Rights (SDR) underlying the equilibrium exchange rate (further details are provided in the Data section). We consider five major currencies: the US dollar (USD), the euro (EUR), the British pound (GBP), the Japanese yen (JPY), and the Chinese renminbi (RMB). The reasons for considering these currencies as anchors are diverse. First, these currencies correspond to those of the most important trade partners, and we can safely assume that in their strategy, the authorities would be interested in stabilizing their exchange rate against those of the major trade partners. This strategy also includes the desire to attract capital flows. Second, developing countries like those considered in this paper, borrow in foreign currencies —the *original sin*— and as a result, their external debt stocks are composed of a number of these currencies. We can also assume that countries would be willing to stabilize their exchange rate against these currencies to avoid considerable valuation effects.

Under the null hypothesis of a basket peg, the equation to be estimated to derive for each country the anchor weights is the following:

$$\Delta e^*_{i/SDR_t} = \beta_0 + \prod_{j}^{M} \beta_j \Delta e_{j/SDR_t} + u_t \; ; \quad with \; j = \{USD, EUR, GBP, JPY, RMB\} \tag{6}$$

where $\Delta e^*_{i/SDR_t}$ denotes the log-change of the equilibrium bilateral exchange rate *vis-*

à-vis the SDR of country i. Similarly, $\Delta e_{j/SDR_t}$ represents the log-change in the anchor currency j expressed in terms of SDR.

The reason to work in terms of changes rather than levels is beyond the simple existence of a unit root. Indeed, using first-differences, we can include a constant term —β_0 in Equation (6)— which captures the average rate of appreciation or depreciation (as in the case of a crawling peg). Also, as aforementioned, in estimating Equation (6), we impose the constraint that the coefficients on the anchor currencies sum to 1. Doing so, β_j can be interpreted as the weight associated with currency j in the hypothetical basket peg. However, the method is flexible enough to cover the full spectrum of ERR. Indeed, if none of the estimated weights are significant, that is to say, the domestic currency could not have been considered as a combination of the major currencies, then the basket peg hypothesis does not hold. Instead, a floating regime would have been preferable. If one of the β_j does not significantly differ from unity, and all others do not differ from zero, then a unitary peg to currency j would have been preferable for the domestic currency. In other cases, the basket peg fits the best.[7]

Finally, the choice of the SDR as the numeraire is motivated by two main reasons. First, monetary authorities generally do not monitor their exchange rate towards a single currency, but instead focus on several key currencies. Second, it should help minimize the possibility of correlation between the error term and the numeraire (see Frankel and Wei, 1994; Bénassy-Quéré, 1999).

3.2 Data

Data are quarterly and cover the 1999-2018 period. The main dependent variable of the analysis is the bilateral nominal exchange rate —*vis-à-vis* the SDR— underlying the equilibrium exchange rate (NER^*). As detailed in Coudert et al. (2019), this measure is obtained by deconstructing the equilibrium real effective exchange rate ($ERER$). The procedure consists of two steps. In the first step, the $ERER$ is deconstructed using the real effective exchange rate ($REER$) formula to derive the nominal effective exchange rate ($NEER$) underlying the $ERER$. The NER^* is then deduced in the second step, relying on the trade weights used for the computation of the effective exchange rates and

[7]Also note that Equation (6) is particularly well specified (i.e., significant coefficients and R^2 close to 1) under the null hypothesis that the domestic currency is determined as a basket peg (or a crawling peg). Consequently, a low R^2 would indicate an intermediate or a flexible regime. Moreover, it should be noted that the null hypothesis of the model —i.e., a peg— is compatible with the need of credibility —in developing countries— in order to overcome market pressures, attract foreign investors, and find an anchor for the expectations of inflation.

a numeraire currency (the SDR). NER^* thus corresponds to the level of the exchange rate *vis-à-vis* the SDR that would have allowed reaching the equilibrium.

To derive the NER^*, we used the estimated equilibrium exchange rates from the *EQCHANGE* database (CEPII; see Couharde et al., 2018) as well as the included trade weights. More specifically, we selected the ERER based on 186 trade partners —time-varying weights— and averaged over five models and different estimation samples (world, by development level, and geographical zones).[8] In deconstructing the ERER (first step), we relied on consumer price index data from the IMF *World Economic Outlook* database. The different exchange rates *vis-à-vis* the SDR are from the IMF *International Financial Statistics* database.

4 Assessing heterogeneity between ECOWAS countries

4.1 HAC analysis

The results from the HAC analysis over the 1999-2018 period are reported in Figure 2. They are presented as dendrograms, which are "cluster trees", indicating the order in which the successive aggregations were made (and therefore the optimal groupings). While the horizontal axis displays the different countries, the dendrograms' vertical axis represents the distance between the objects (i.e., the countries' equilibrium exchange rate paths) and between the clusters (heights of the cluster junctions).

As can be seen, the results are consistent across the four different methods we rely on. Indeed, we identify the same groupings of countries that could delimit the *ECO* area's borders. A simplified —but still relevant— interpretation of the results leads us to distinguish two groups of countries. The first group is composed of Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. The second set of countries, relatively less homogenous, is made of Gambia, Ghana, Guinea, and Nigeria. As shown, our two clusters of countries correspond to the WAEMU countries and Cabo Verde for the first one, and most WAMZ countries for the other. Sierra Leone can also be included in the second set of countries, even if it appears as an outlier gravitating relatively close to this group. In contrast, Liberia is an outlier as it is joined at a much higher distance compared to the other countries. It is worth mentioning that Sierra Leone and Liberia are the two countries exhibiting the lowest GDP growth rates (Figure 1), and very high inflation rates (more than 17% in Sierra Leone in 2017).

[8]The fundamentals considered in the various models are proxies of the Balassa-Samuelson effect (relative productivity), the net foreign asset position, terms of trade, the government spending, and trade openness.

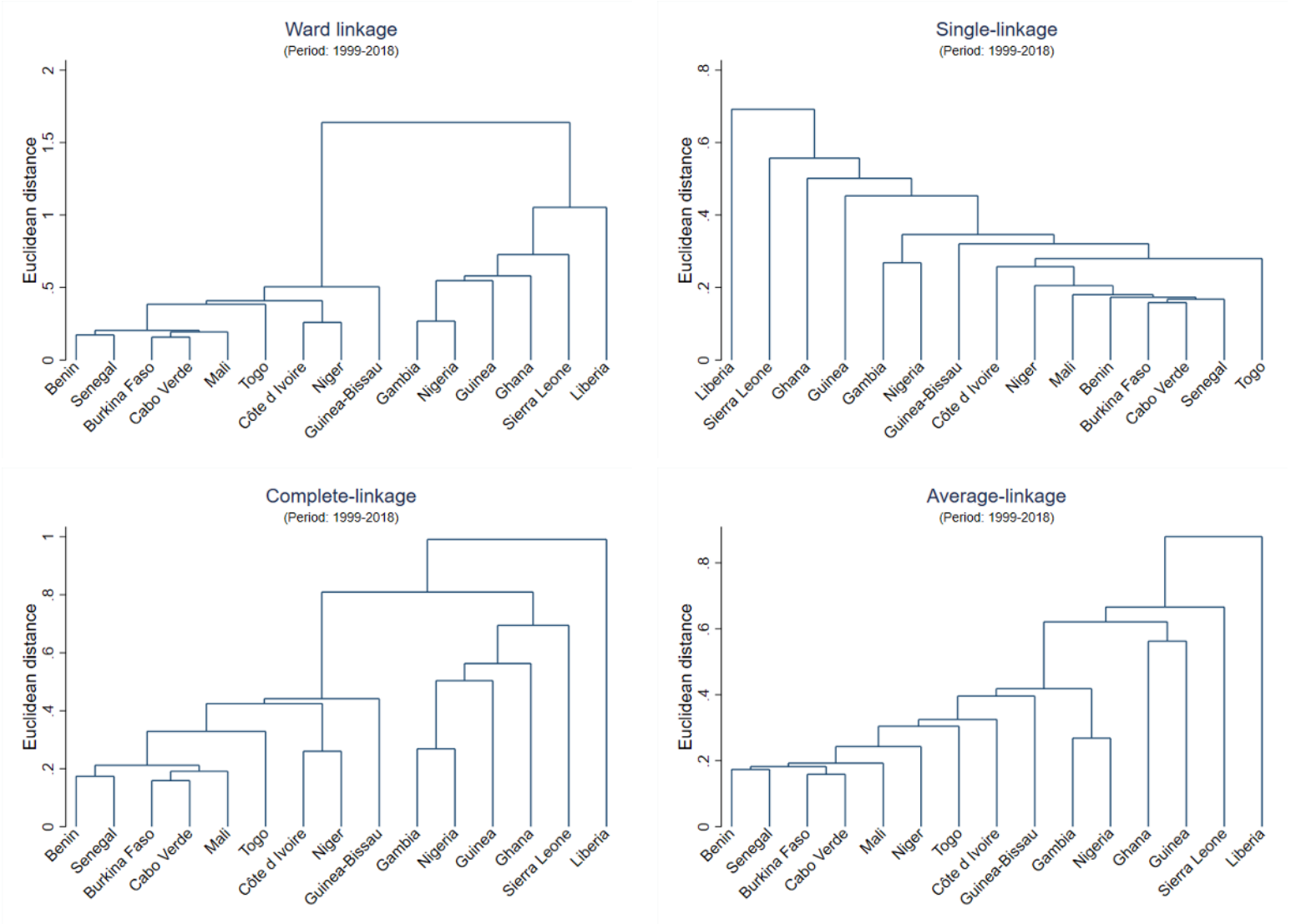

Figure 2 — HAC analysis results (1999-2018)

The identification of these two groups of economies attests of a considerable heterogeneity between the countries that could challenge the viability of the monetary union at the ECOWAS level. Such heterogeneity illustrates the absence of integration across West African countries. Indeed, as previously mentioned, they mainly trade with Europe, China, the United States, and other emerging Asian countries, but not within the region. Although we mobilize a different methodological approach, the groupings we identify are quite in line with those from previous studies. For instance, relying on the OCA theory, Tsangarides and Qureshi (2008) identify relatively similar groups of countries with, on the one hand, the WAEMU countries and Cabo Verde and, on the other hand, the WAMZ states. Our groups of countries are also consistent with those of Coulibaly and Gnimassoun (2013).

4.2 Robustness check: factor analysis

Besides the key issues of countries' groupings and choice of the ERR in the perspective of regional integration, identifying the causes of heterogeneity—frequently mentioned in the literature, but rarely documented— is equally essential. Indeed, such an examination is of major interest to establish milestones in the convergence process. To that end, we perform a factor analysis with the aims of (i) identifying the common features shared by the different countries, and (ii) double-checking our above findings regarding the partitions of the ECOWAS area. Accordingly, we collect data on several key variables reflecting macroeconomic structures/conditions as well as imbalances, and perform a factor analysis to identify the structural economic differences between the countries emphasized by the cluster analysis.

4.2.1 Selection of indicators

We take full advantage of the factor analysis procedure to identify the structural differences that underlie the clusters identified above. Indeed, factor analysis is a powerful multivariate explorative analysis tool that allows us to gather together several variables with similar patterns and to contain most of the information into a few interpretable unobserved (underlying) variables, called factors. Most specifically, factor analysis is a data reduction technique that aims to reduce the dimension of the observations by grouping p observed variables into a lower number, say k, of factors. For this purpose, the p variables are modeled as a linear combination of the potential factors (i.e., latent unobserved variables that are reflected in the behavior of the observed variables) plus an

error term. Consequently, factor analysis is a useful tool to detect the structure of the relationships between the variables. Let us assume we have a set of p observable random variables ($Y_1, \ldots, Y_p$). From these p observed variables, factor analysis aims at identifying k common factors which linearly reconstruct the original variables as follows:

$$Y_{ij} = Z_{i1}\gamma_{1j} + Z_{i2}\gamma_{2j} + ... + Z_{ik}\gamma_{kj} + u_{ij} \tag{7}$$

where Y_{ij} is the value of the i^{th} observation of the j^{th} variable ($j = 1, \ldots, p$), Z_{il} is the value of the i^{th} observation of the l^{th} common factor ($l = 1, \ldots, k$), the coefficients γ_{lj} denote the factor loadings ($l = 1, \ldots, k$), and the error term u_{ij} is the unique factor of the j^{th} variable.

While the promises associated with the factor analysis are attractive, they depend on the upstream variables' selection. This latter should be dictated by a search for parsimony and not comprehensiveness that would inevitably set out factors hardly interpretable. As a consequence, we select 9 determinants among a large set of variables, including fundamentals: (*i*) agriculture value-added, (*ii*) current account balance, (*iii*) fiscal balance, (*iv*) real growth, (*v*) industry value-added, (*vi*) inflation (based on consumer price index), (*vii*) currency misalignment, (*viii*) services value-added, and (*ix*) terms-of-trade volatility (proxied by the standard deviation).[9] The selection of these variables obeys several imperatives, such as the need to account for the economies' internal and external balances —and their dynamics— as well as their key economic features. The inflation rate (measuring price stability), the fiscal balance (measuring the soundness and sustainability of public finances), and real GDP growth are considered to gauge the economies' internal equilibrium. Regarding the external balance, rather than including several —medium to long-term— key determinants such as the net foreign asset position, output gap, trade openness, and demographic variables (see e.g., Chinn and Prasad, 2003; Cheung et al., 2010), we take advantage of the all-encompassing —and so parsimonious— nature of the current account-to-GDP ratio that synthesizes several determinants. The nature of the economic structure is also taken into account through the sectoral (i.e., agriculture, industry, and services) value-added-to-GDP ratios. Finally, the terms-of-trade volatility proxies the sensitivity to real shocks, while currency misalignments account for imbalances —from various sources— not accounted directly.[10]

[9]Table A.1 in Appendix A provides more details regarding the sources and calculations of the data.

[10]It is worth mentioning that while other variables could have been considered, their availability or reliability played a key role in the selection. This was for instance the case for the unemployment rate, which is a key variable to gauge the internal equilibrium. This latter was left apart because for the considered countries, only estimates —and by the way highly questionable— were available. In a somewhat different vein, we do not take into account the debt-to-GDP ratio since it does not reflect the

4.2.2 Factor analysis results

The detailed results of the factor analysis are reported in Appendix B.2, with Table B.2.1 presenting the data used. We deemed relevant to focus on the 2010-2018 period, i.e., the period after the global financial crisis, the latter having fundamentally altered the 2000s economic picture.

As shown in Table B.2.2 in Appendix B, only the first five factors are retained —as the eigenvalues associated with the other factors are negative. However, to ease the representation and so the analysis/interpretation, we focus on the first three most meaningful factors —explaining the major part (around 84%) of the total variance.

The first factor (*Factor 1*) has, on the one hand, a high and positive correlation with the *current account balance*, *industry*, and *services*, and, on the other hand, a negative correlation with *agriculture* (see Table B.2.3). Thus, *Factor 1* principally opposes predominantly agrarian economies (left side) and economies where industry and services are predominant. Accordingly, this first factor can be interpreted as the "type of economy axis". The second factor principally opposes, on the left side (negative correlation), *services*, and *real GDP growth* on the right side (positive correlation). Finally, *Factor 3*, for its part, principally opposes *inflation* and *currency misalignments*.[11]

The results of the factor analysis (the first three factors) are synthesized in two three-dimensional graphics (see Figure 3). The top chart, i.e., the factor loadings plot, displays each variable's position in the space defined by the first three factors. Its aim is to identify clusters of variables with similar loadings. The bottom chart ("Scores") displays individual countries' score on each factor, the values being provided in Table B.2.5. The closer the country is to a variable, the more important is the score of the country regarding this variable.

It is interesting to note the concordance of the countries' groupings between the factor analysis and the cluster analysis. Indeed, Ghana, Guinea, Guinea-Bissau, Sierra Leone, and Liberia appear clearly distant from the cluster formed by the —core— WAEMU countries (Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal, and Togo). These latter WAEMU countries appear in the space delimited by the current account balance, currency misalignments, fiscal balance, and real GDP growth. Therefore, these countries tend to exhibit the highest average scores (i.e., better performances) regarding the afore-

soundness and sustainability of public finances due to various and considerable debt reliefs including the HIPC (Heavily Indebted Poor Country) initiative.

[11] From a methodological point of view, our results are satisfying given the low values of the uniqueness (Table B.2.3). Indeed, recall that uniqueness measures the percentage of variance for the considered variable that is not explained by the common factors. Uniqueness could represent measurement error, which is likely if it takes a high value, typically larger than 0.6. Given that the values we obtain do not exceed this threshold, our retained variables are well explained by the identified factors.

mentioned variables. In contrast, Guinea-Bissau, which belongs to the WAEMU, has a remote position from the cluster. Its eccentric position is due to the difference regarding the scores on *Factor* 1 and 3 (see Table B.2.5). Indeed, Guinea-Bissau appears to be not only a more agrarian economy than other WAEMU countries (*Factor 1*), but also overvalued (*Factor 3*) over the 2010-2018 period —in contrast with the other WAEMU countries except Benin. In line with the HAC results, Gambia and Nigeria fall between the two above noted and distinct groups. More specifically, their positions differ from the WAEMU cluster mostly due to one factor; *Factor 2* in the case of Gambia and *Factor 3* in the case of Nigeria. Indeed, Gambia registered on average lower real GDP growth rates, and the services sector's size is substantially different from that of WAEMU countries —except Côte d'Ivoire. For Nigeria, the main difference is related to the high inflation level that reflects a difference in the internal macroeconomic equilibrium. Also, as found in our previous analyses, Cabo Verde belongs to the —core— WAEMU cluster, but its position is here distorted due to both the relatively lower growth rate observed over the 2010-2018 period, and the preponderance of the services sector —which is typical for a tourism-oriented economy.

Overall, while the WAEMU countries (excluding Guinea-Bissau) seem to form a rather homogenous group regarding the different variables, the other countries' positions appear more dispersed in the space defined by the three factors, hence revealing important structural differences. These findings support the conclusions of the HAC analysis. Indeed, both approaches highlight an important level of heterogeneity between the ECOWAS countries, and the agglomerative schemes arising from the two approaches are quite similar.

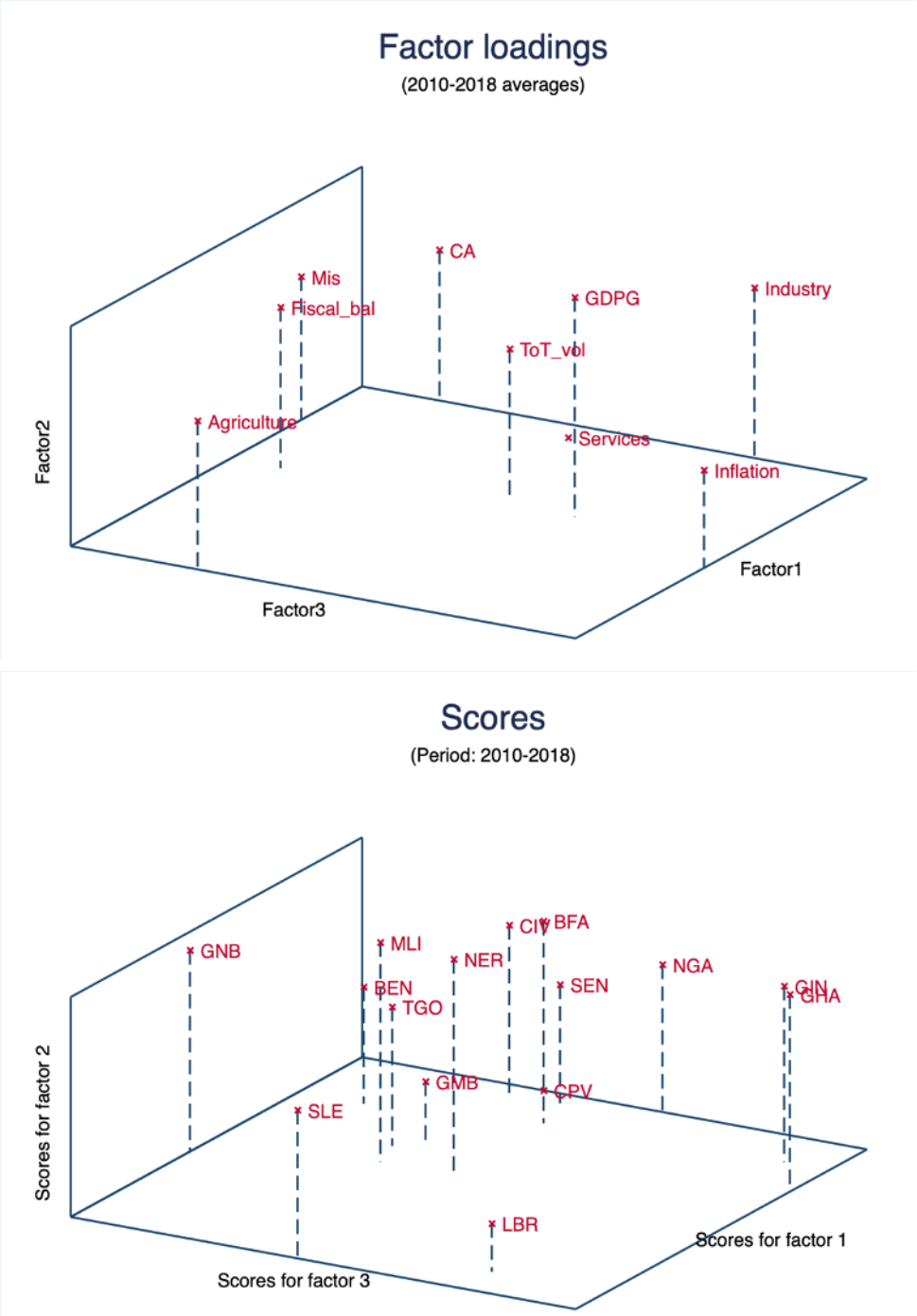

Figure 3 — Factor analysis results (2010-2018)

Notes: The height of the spikes indicates the score on Factor 2, while the basis of the spikes positions the variables or the countries in the Factor1-Factor 3 plane. "*Agriculture*" = agriculture value added (%GDP); "*CA*" = current account balance (%GDP); "*Fiscal_bal*" =fiscal balance (%GDP); "*GDPG*"= real GDP growth; "*Industry*" = industry valued added (%GDP); "*Inflation*"=CPI-based inflation; "*Mis*" = currency misalignments; "*Services*"= services value added (%GDP); "*ToT_vol*" = Terms of trade volatility. Country labels use International Organization for Standardization (ISO) country codes: "BEN" Benin; "BFA" Burkina Faso; "CIV" Côte d'Ivoire; "CPV" Cabo Verde; "GHA" Ghana; "GIN" Guinea; "GMB" Gambia; "GNB" Guinea-Bissau; "LBR" Liberia; "MLI" Mali; "NER" Niger; "NGA" Nigeria; "SEN Senegal; "SLE" Sierra Leone; "TGO" Togo.

5 Choice of the exchange rate regime

As noted above, an additional issue raised by the *ECO* project is that of the ERR choice. While the previous results indicate the existence of two groups of countries with more or less similar sustainable exchange rate paths, they do not say anything about the ERR to be adopted. This ERR choice is, however, of first importance as it conditions the adjustment capacities —and so the realization of the macroeconomic balances. The ERR issue could also serve as a double-check. Indeed, it is not inconceivable that two countries share the same underlying ERR despite the difference regarding their sustainable exchange rate paths. Hence, we go further than the previous studies in the sense that our analysis passes the wall of heterogeneity between countries by also looking at their ERR.

Overall, the results from this second step are in line with the previous ones. As shown in Table B.1 in Appendix B, the different countries identified above share similar underlying ERR. First, it is worth mentioning that no single currency peg is desirable for any country. Instead, we show that a peg to a basket of currencies with a certain degree of flexibility would be preferable. The need for more flexibility is especially important for the second group of countries to which Nigeria belongs. Drawing on the above results (i.e., the similarity of the ERR within the groups), we present in Table 2 the different anchor currency weights for each of the country groups. As in Table B.1, we retain three alternatives for the basket peg: (*i*) a basket composed of euro and US dollar, (*ii*) a basket of four currencies (US dollar, euro, British pound, and renminbi), and (*iii*) a basket of five currencies (US dollar, euro, British pound, renminbi, and yen).

Looking first at the WAEMU countries, we note that the coefficient of determination (R^2) varies between 0.661 for the two-anchor basket and 0.888 for the five-anchor basket. For each of the estimated model, the null of the Fisher test that all of the slope coefficients are zero is rejected, indicating the plausibility of the basket peg hypothesis. This latter should *a priori* be mainly composed of euro and US dollar —with a slightly more important share of euro than US dollar. The GBP and JPY could also enter this basket, but with relatively weak weights. In contrast, the renminbi should not be included —directly— in the basket.[12] The picture for the WAEMU is unchanged when including Cabo Verde.

[12]Given the relatively tight link between the US dollar and the renminbi, the latter could be indirectly taken into account through the US dollar —see the correlations in Table A.2 in Appendix A.

Table 2 — The country groups' underlying exchange rate regimes

	Group 1						Group 2					
	WAEMU			WAEMU and Cabo Verde			WAMZ excluding Liberia			WAMZ and Liberia		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
USD	0.481***	0.454***	0.397***	0.476***	0.460***	0.399***	0.523***	0.426***	0.330***	0.545***	0.317***	0.200**
	(0.014)	(0.042)	(0.042)	(0.013)	(0.039)	(0.038)	(0.025)	(0.078)	(0.077)	(0.031)	(0.094)	(0.093)
EUR	0.519***	0.485***	0.442***	0.524***	0.488***	0.443***	0.477***	0.416***	0.343***	0.455***	0.358***	0.269***
	(0.014)	(0.021)	(0.021)	(0.013)	(0.019)	(0.019)	(0.025)	(0.038)	(0.039)	(0.031)	(0.046)	(0.047)
GBP		0.046**	0.077***		0.050**	0.083***		0.077*	0.130***		0.111**	0.176***
		(0.022)	(0.022)		(0.020)	(0.020)		(0.040)	(0.040)		(0.048)	(0.048)
RMB		0.015	-0.005		0.002	-0.018		0.081	0.048		0.214**	0.173*
		(0.044)	(0.042)		(0.040)	(0.039)		(0.081)	(0.078)		(0.097)	(0.094)
JPY			0.089***			0.093***			0.150***			0.182***
			(0.014)			(0.013)			(0.026)			(0.031)
$Constant$	0.001**	0.001**	0.001**	0.001**	0.001**	0.001***	-0.020***	-0.020***	-0.020***	-0.020***	-0.020***	-0.020***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R-squared	0.661	0.710	0.888	0.669	0.725	0.894	0.517	0.488	0.768	0.402	0.319	0.643
F test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N° Obs.	632	632	632	711	711	711	395	395	395	474	474	474

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% statistical level. The regressions are based on quarterly data over the 1999-2018 period. WAEMU (West African Economic and Monetary Union) is formed of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. The WAMZ (West African Monetary Zone) countries are Gambia, Ghana, Guinea, Liberia, Nigeria, and Sierra Leone. "*F test*" reports the p-value associated with the Fisher test.

Turning now to the second set of economies, the lower R^2 values suggest that these countries' need for flexibility is larger than that of the countries belonging to the first group.[13] Besides, the anchor currencies are more diverse, with relatively more important weights attributed to the GBP and JPY compared to the basket of Group 1. For the sample including Liberia, the renminbi even enters with a significant weight.

Interestingly, our analysis also shows differences in the countries' adjustment speeds / horizons towards the equilibrium exchange rates. Table 3 presents the estimated adjustment speeds and the corresponding half-lives to get an idea of these different horizons.[14] As shown, there is substantial heterogeneity across countries regarding the time needed to absorb currency disequilibria. Gambia, Burkina Faso, Ghana, and Senegal are among the states exhibiting the highest half-life values. In contrast, Sierra Leone, Côte d'Ivoire, Capo Verde, and Benin tend to correct quite rapidly the imbalances.

Table 3 – The adjustment speeds

	Error correction term		Corresponding
	Mean	Std. Dev.	half-life (years)
Benin	-0.264	0.156	2.96
Burkina Faso	-0.060^a	0.012	11.89
Cabo Verde	-0.302	0.155	2.63
Côte d'Ivoire	-0.507	0.082	1.69
Gambia	-0.048^a	0.009	14.88
Ghana	-0.083	0.010	8.69
Guinea	-0.171	0.106	4.39
Guinea-Bissau	-0.254	0.054	3.06.
Liberia	-0.108	0.026	6.75
Mali	-0.108	0.038	6.77
Niger	-0.118	0.057	6.20
Nigeria	-0.244	0.083	3.17
Senegal	-0.089	0.003	8.17
Sierra Leone	-0.508	0.162	1.69
Togo	-0.157	0.011	4.75
Average			5.85

Note: The entries correspond to the averages of the estimated error correction terms –statistically significant at the 10% statistical level– over the 5 estimated equilibrium exchange rate models. Std. Dev. stands for standard deviation. "a" indicates significance at 15%. The corresponding half-lives (in years) are calculated using these averages as follows: $|(log(0.5))/(log(1-\gamma))|; with \gamma$ denoting the estimated value of the error-correction term.

Overall, the different analyses put forward several insightful results regarding the

[13]Indeed, despite the relatively low R^2, the null of the $F-test$ is rejected indicating therefore the plausibility of the basket peg.

[14]A half-life here indicates, *ceteris paribus*, the time necessary to reduce by half the currency misalignments.

implementation of the West African monetary union project. The bottom line is that of the *ECO*, in a first phase, as a *common* currency and not a single currency. Given the heterogeneity between the economies, two distinct "ECOs" are indeed desirable; one for each of the above-identified groups of countries. More specifically, for each group, the national currencies would be pegged to the *ECO* with a certain degree of flexibility —e.g., fluctuation bands— and the possibility to adjust the parities. In turn, the *ECO* would consist of a virtual course determined by the consistent basket of currencies. This first phase of the implementation of the ECOWAS monetary union presents additional advantages. As Table 3 indicates relatively far adjustment horizons, this first step could serve as a convergence period in both nominal and real terms. More importantly, on the one hand, by disposing of the two economic policy instruments —i.e., fiscal and monetary— and on the other hand, by focusing on national objectives, the authorities would be more likely to give impetus for the urgent structural changes.[15]

6 Conclusion

This paper examines the desirability of the ECOWAS monetary union project by relying on a two-step methodology. The approach retained is that of the coordination of the candidate countries' sustainable exchange rate trajectories proxied here by the equilibrium exchange rate paths. The equilibrium exchange rate being defined as the value of the exchange rate allowing an economy to reach both its internal and external balances, our approach is thus articulated around the inclusion of national objectives from the perspective of regional integration.

Relying on a clustering method and a factor analysis, we identify two relatively homogeneous subgroups of countries within the region. The first group is composed of Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. The second set of countries is made of Gambia, Ghana, Guinea, and Nigeria. Sierra Leone can also be included in this second set of countries, even if it may be viewed as an outlier gravitating relatively close to this group. In contrast, Liberia is clearly found to be an outlier. While this heterogeneity within the region is presented as an obstacle by previous studies, we go further by investigating whether, despite their differences, the countries could actually share a similar sustainable exchange rate regime —i.e., the exchange rate regime underlying the sustainable exchange rate path. Turning to the second step of our

[15]The issue of whether these two *ECO* zones would fuse in the future is too early to say. An evaluation —similar to the above exercises— should be made at the end of the —long— convergence period to assess whether this fusion is desirable or not. This latter would normally be obvious if things go well because the two ECOs would stabilize with the intensification of trade and capital flows.

methodology used to identify *de facto* ERR, we show that no single currency peg nor freely floating ERR would be preferable for any of the considered countries. Instead, our results indicate that a basket peg with some flexibility would be preferable. Our analysis, therefore, helps in evaluating the desirability of alternative monetary arrangements compared to the existing ones, and the results send a strong signal to the WAEMU countries that have decided to stick to their peg to the euro.

Overall, our findings argue in favor of two distinct zones —in a first phase— as delimited by the cluster and factor analyses. Within each zone, countries should peg their national currency —with some flexibility (e.g., fluctuation bands, possibility to adjust)— to their *ECO*; the *ECO* itself should be determined by the consistent basket of currencies. However, this first step should last a sufficiently long period to ensure both nominal and real convergence. Finally, it is worth recalling the key role that a real political determination will play in constructing this monetary union.

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Appendices

A. Data

Table A.1 — The variables

Variable	Source
Age dependency ratio (% of working-age population)	WDI
Consumer price index	WEO
Currency misalignments (%)	EQCHANGE
Current account balance (%GDP)	WEO
Domestic credit provided by financial sector (% GDP)	WDI
Equilibrium exchange rates	EQCHANGE
Exchange rate *vis-à-vis* the Special Drawing Rights	IFS
Fiscal balance	WEO
Foreign direct investment, net inflows (% GDP)	WDI
GDP growth	
Inflation, consumer prices (annual %)	WDI
Lending interest rate (%)	WDI
Manufacturing, value added (% GDP)	WDI
Output gaps: cyclical component of GDP (HP filter); GDP are from the WEO database	
Population growth (annual %)	WDI
Public Debt (%GDP)	WEO
Reserves	WEO
Revenue, excluding grants (% GDP)	WDI
Tax revenue (% GDP)	WDI
Terms of trade	WDI
Trade flows (average imports and exports flows)	EQCHANGE
Value added (agriculture, industry and services; %GDP)	WDI

Notes: *EQCHANGE* (CEPII); IFS: *International Financial Statistics* (International Monetary Fund); WEO: *World Economic Outlook* (International Monetary Fund); WDI : *World Development Indicators* (World Bank).

Table A.2 – The anchor currencies' correlations

	USD	EUR	GBP	RMB	JPY
USD	1.000				
EUR	-0.852 (0.00)	1.000			
GBP	-0.434 (0.00)	0.354 (0.00)	1.000		
RMB	0.766 (0.00)	-0.685 (0.00)	-0.315 (0.01)	1.000	
JPY	0.007 (0.95)	-0.363 (0.00)	-0.522 (0.00)	-0.012 (0.91)	1.000

Note: Entries correspond to the correlation between the anchor currency changes over the 1999-2018 period. p-values are reported in parentheses.

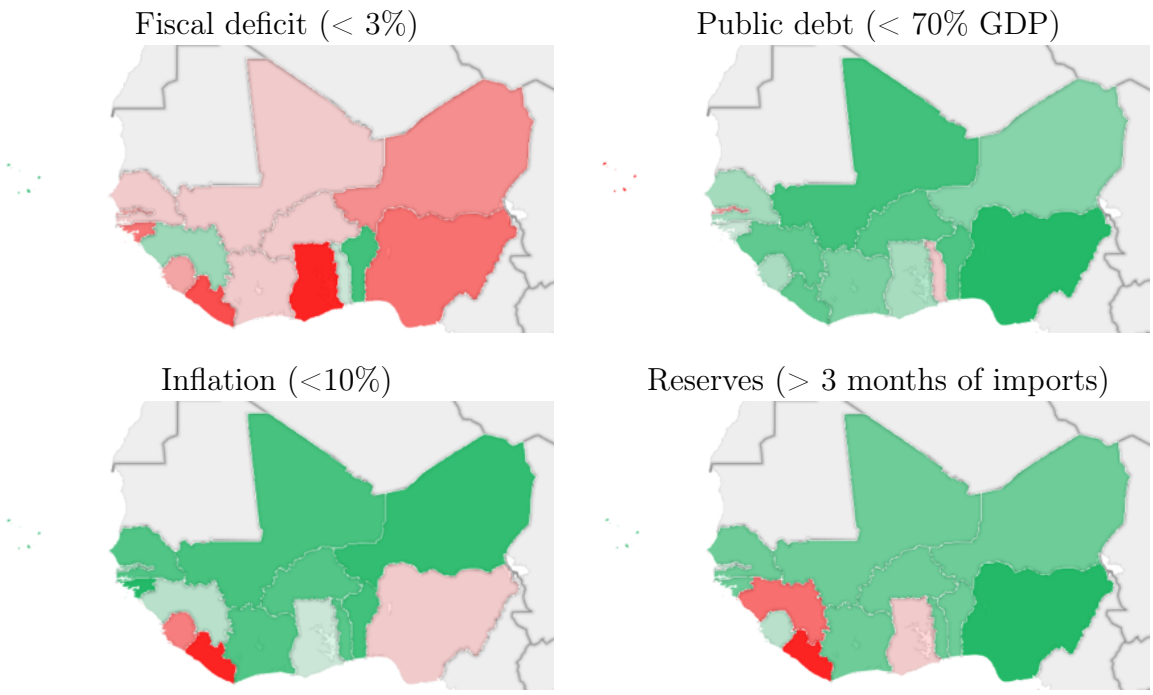

Figure A.1 — Convergence criteria in 2019

Note: The color shades indicate the distance to the target. Shades of red indicate countries that do not satisfy the criteria; the more red is the country, the higher the distance to the target. Vice versa for countries in green.

B. Additional results

B.1. The countries' anchor currency weights

Table B.1.1 — The countries' anchor currency weights

	Benin			Burkina Faso			Cabo Verde			Côte d'Ivoire		
	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)
USD	0.464***	0.442***	0.420***	0.463***	0.504***	0.420***	0.439***	0.504***	0.419***	0.458***	0.350**	0.336**
	(0.027)	(0.081)	(0.082)	(0.032)	(0.097)	(0.089)	(0.029)	(0.087)	(0.077)	(0.043)	(0.135)	(0.139)
EUR	0.536***	0.472***	0.456***	0.537***	0.488***	0.424***	0.561***	0.512***	0.448***	0.542***	0.555***	0.544***
	(0.027)	(0.039)	(0.042)	(0.032)	(0.047)	(0.045)	(0.029)	(0.042)	(0.039)	(0.043)	(0.066)	(0.070)
GBP		0.090**	0.102**		0.077	0.123***		0.079*	0.126***		-0.032	-0.024
		(0.041)	(0.042)		(0.050)	(0.046)		(0.044)	(0.040)		(0.069)	(0.071)
RMB		-0.004	-0.011		-0.069	-0.098		-0.095	-0.124		0.128	0.123
		(0.083)	(0.083)		(0.100)	(0.090)		(0.090)	(0.078)		(0.139)	(0.140)
JPY			0.033			0.131***			0.131***			0.021
			(0.028)			(0.030)			(0.026)			(0.046)
Constant	-0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
R-squared	0.798	0.856	0.952	0.735	0.811	0.934	0.755	0.854	0.950	0.591	0.669	0.873
F test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Gambia			Ghana			Guinea			Guinea-Bissau		
	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)
USD	0.558***	0.094	0.028	0.436***	0.314*	0.216	0.579***	0.737***	0.659***	0.525***	0.547***	0.448***
	(0.041)	(0.110)	(0.108)	(0.058)	(0.180)	(0.178)	(0.046)	(0.143)	(0.142)	(0.053)	(0.166)	(0.163)
EUR	0.442***	0.306***	0.256***	0.564***	0.482***	0.408***	0.421***	0.441***	0.381***	0.475***	0.469***	0.394***
	(0.041)	(0.054)	(0.054)	(0.058)	(0.088)	(0.090)	(0.046)	(0.070)	(0.071)	(0.053)	(0.081)	(0.082)
GBP		0.140**	0.176***		0.104	0.158*		-0.008	0.035		0.011	0.065
		(0.056)	(0.056)		(0.092)	(0.091)		(0.073)	(0.073)		(0.085)	(0.084)
RMB		0.461***	0.438***		0.100	0.067		-0.170	-0.197		-0.026	-0.060
		(0.114)	(0.109)		(0.186)	(0.180)		(0.148)	(0.143)		(0.172)	(0.165)
JPY			0.102***			0.151**			0.122**			0.153***
			(0.036)			(0.060)			(0.047)			(0.055)
Constant	-0.012***	-0.013***	-0.013***	-0.029***	-0.029***	-0.029***	-0.026***	-0.025***	-0.025***	0.004*	0.004*	0.004**
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
R-squared	0.709	0.631	0.909	0.421	0.551	0.778	0.670	0.609	0.839	0.559	0.543	0.791
F test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: Symbols ***, **, and * denote significance at the 1%, 5%, and 10% statistical level. The estimations are based on the 1999-2018 period using quarterly data. "*F test*" reports the p-value associated with the Fisher test.

Table B.1.1 — The countries' anchor currency weights (*Continued*)

	Liberia			Mali			Niger			Nigeria		
	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)
USD	0.657***	-0.229	-0.450	0.484***	0.605***	0.533***	0.464***	0.344***	0.300**	0.523***	0.307**	0.192*
	(0.133)	(0.397)	(0.392)	(0.034)	(0.105)	(0.101)	(0.037)	(0.113)	(0.114)	(0.041)	(0.120)	(0.107)
EUR	0.343**	0.071	-0.097	0.516***	0.498***	0.443***	0.536***	0.482***	0.449***	0.477***	0.350***	0.262***
	(0.133)	(0.194)	(0.198)	(0.034)	(0.051)	(0.051)	(0.037)	(0.055)	(0.057)	(0.041)	(0.059)	(0.054)
GBP		0.283	0.405**		0.043	0.083		0.063	0.088		0.159**	0.222***
		(0.203)	(0.201)		(0.054)	(0.052)		(0.058)	(0.059)		(0.061)	(0.055)
RMB		0.875**	0.799**		-0.146	-0.170*		0.111	0.096		0.184	0.145
		(0.410)	(0.396)		(0.108)	(0.102)		(0.117)	(0.115)		(0.124)	(0.108)
JPY			0.343**			0.111***			0.069*			0.178***
			(0.131)			(0.034)			(0.038)			(0.036)
Constant	-0.018***	-0.019***	-0.018***	0.003**	0.004**	0.004***	-0.002	-0.002	-0.002	-0.017***	-0.017***	-0.017***
	(0.006)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
R-squared	0.241	0.075	0.351	0.724	0.787	0.918	0.675	0.739	0.905	0.681	0.668	0.899
F test	0.000	0.116	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Senegal			Sierra Leone			Togo		
	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)	(*i*)	(*ii*)	(*iii*)
USD	0.477***	0.464***	0.402***	0.520***	0.678***	0.552**	0.512***	0.379**	0.316**
	(0.024)	(0.075)	(0.070)	(0.078)	(0.243)	(0.242)	(0.050)	(0.155)	(0.156)
EUR	0.523***	0.499***	0.452***	0.480***	0.501***	0.406***	0.488***	0.420***	0.373***
	(0.024)	(0.037)	(0.035)	(0.078)	(0.119)	(0.122)	(0.050)	(0.076)	(0.079)
GBP		0.033	0.067*		-0.011	0.058		0.082	0.117
		(0.038)	(0.036)		(0.125)	(0.124)		(0.079)	(0.080)
RMB		0.004	-0.017		-0.168	-0.211		0.119	0.098
		(0.078)	(0.071)		(0.251)	(0.244)		(0.160)	(0.158)
JPY			0.096***			0.195**			0.097*
			(0.023)			(0.081)			(0.052)
Constant	0.002*	0.002*	0.002**	-0.016***	-0.016***	-0.015***	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
R-squared	0.835	0.868	0.960	0.365	0.387	0.613	0.575	0.562	0.826
F test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: Symbols ***, **, and * denote significance at the 1%, 5%, and 10% statistical level. The estimations are based on the 1999-2018 period using quarterly data. "*F test*" reports the p-value associated with the Fisher test.

B.2. The factor analysis results

Table B.2.1 — The data

Country (ISO)	Mis	$Fiscal\_bal$	CA	$Inflation$	$GDPG$	$Agriculture$	$Industry$	$Services$	ToT_vol
Benin (BEN)	9.7	-2.4	-5.2	1.4	4.3	26.6	16.7	47.8	5.9
Burkina Faso (BFA)	-13.1	-3.5	-5.0	1.3	5.7	22.8	25.0	42.6	14.4
Côte d'Ivoire (CIV)	-23.0	-2.2	1.0	1.5	5.9	21.1	23.0	53.0	9.9
Cabo Verde (CPV)	5.6	-6.5	-9.3	1.2	2.1	7.8	18.1	61.2	4.4
Ghana (GHA)	-30.6	-6.6	-7.0	12.8	6.6	22.4	27.9	43.3	7.2
Guinea (GIN)	-42.5	-3.5	-10.7	11.3	5.4	17.7	29.5	42.9	5.4
Gambia (GMB)	-36.0	-4.3	-5.1	5.9	2.9	25.5	14.0	53.2	2.6
Guinea-Bissau (GNB)	6.6	-2.0	-2.9	1.3	4.1	45.6	13.1	38.1	9.2
Liberia (LBR)	-136.5	-3.4	-26.8	10.0	3.9	40.5	10.9	47.7	11.5
Mali (MLI)	-31.9	-2.9	-5.8	1.4	4.4	36.2	19.8	35.8	13.4
Niger (NER)	-11.1	-3.4	-13.5	1.3	5.7	34.9	21.5	37.8	14.5
Nigeria (NGA)	-14.7	-3.0	2.0	11.9	4.2	21.9	23.9	53.3	39.2
Senegal (SEN)	-17.7	-3.8	-6.5	0.6	4.8	14.4	23.1	52.7	5.1
Sierra Leone (SLE)	-6.3	-5.0	-21.5	9.0	4.8	54.9	9.4	32.8	9.7
Togo (TGO)	-13.6	-5.0	-7.6	1.7	5.7	29.1	16.3	36.3	5.9

Notes : "*Agriculture*" = agriculture value added (%GDP); "CA" = current account balance (%GDP); "$Fiscal\_bal$" =fiscal balance (%GDP); "$GDPG$"= real GDP growth; "$Industry$" = industry valued added (%GDP); "$Inflation$"=CPI-based inflation; "Mis" = currency misalignments (%); "$Services$"= services value added (%GDP); "ToT_vol" = Terms of trade volatility.

Table B.2.2 — Factor analysis (principal factors. unrotated)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	2.47435	0.89746	0.3799	0.3799
Factor 2	1.57689	0.12652	0.2421	0.6221
Factor 3	1.45036	0.52374	0.2227	0.8448
Factor 4	0.92662	0.48687	0.1423	0.9871
Factor 5	0.43976	0.46438	0.0675	1.0546
Factor 6	-0.02462	0.0338	-0.0038	1.0508
Factor 7	-0.05842	0.03431	-0.009	1.0418
Factor 8	-0.09273	0.08704	-0.0142	1.0276
Factor 9	-0.17977	.	-0.0276	1

LR test: independent vs. saturated: chi2(36) = 69.74 | Prob>chi2 = 0.0006

Table B.2.3 — Factor loadings (pattern matrix) and unique variances

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Uniqueness
Mis	0.3875	0.2498	-0.5128	-0.275	0.3592	0.3198
Fiscal_bal	-0.0154	0.362	-0.3858	0.5556	-0.3166	0.3109
CA	0.7313	0.2959	-0.3208	0.1681	0.15	0.224
Inflation	-0.1867	-0.0357	0.7428	0.2355	0.269	0.2843
GDPG	0.0238	0.7307	0.3284	-0.2224	-0.1478	0.2864
Agriculture	-0.9094	0.2829	-0.1972	0.1434	0.1333	0.0157
Industry	0.7228	0.4266	0.4664	-0.07	-0.0983	0.0635
Services	0.6278	-0.6529	0.0453	0.2645	-0.0528	0.1048
ToT_vol	0.1007	0.2691	0.1326	0.5601	0.2522	0.5226

Table B.2.4 — Scoring coefficients

Variable	Factor 1	Factor 2	Factor 3
Mis	0.18206	-0.01314	-0.23482
Fiscal_bal	0.13367	-0.0268	-0.20295
CA	0.15283	0.30685	-0.28449
Inflation	0.02839	-0.22805	0.37137
GDPG	0.02904	0.05582	0.06052
Agriculture	-0.81251	1.05454	0.13133
Industry	0.05007	1.02133	0.59788
Services	0.00349	-0.12089	0.12524
ToT_vol	0.06558	-0.00779	0.01617

Table B.2.5 — Country scores on the factors

Country (ISO)	Factor 1	Factor 2	Factor 3
Benin (BEN)	0.38555	-0.40754	-1.09870
Burkina Faso (BFA)	0.58221	0.85235	-0.01416
Côte d'Ivoire (CIV)	0.83983	0.44781	-0.40144
Cabo Verde (CPV)	1.07933	-2.13196	-0.31798
Ghana (GHA)	0.23373	0.77754	1.84907
Guinea (GIN)	0.66053	0.46612	1.55007
Gambia (GMB)	-0.01444	-1.24381	-0.43943
Guinea-Bissau (GNB)	-0.80614	0.83650	-1.53356
Liberia (LBR)	-1.78487	-1.41546	1.08705
Mali (MLI)	-0.44421	1.10752	-0.47978
Niger (NER)	-0.39647	1.01218	-0.01737
Nigeria (NGA)	1.01872	0.10300	0.51499
Senegal (SEN)	0.92963	-0.38069	-0.11686
Sierra Leone (SLE)	-2.11262	0.05619	-0.01349
Togo (TGO)	-0.17077	-0.07974	-0.56840