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# How Feasible Is the ECO Currency? A Study of ECOWAS Business Cycles Synchronicity

Youssef EL JAI

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**Policy Center for the New South**

Suncity Complex, Building C, Av. Addolb, Albortokal Street, Hay Riad, Rabat, Morocco.
Email : contact@policycenter.ma
Phone : +212 5 37 54 04 04 / Fax : +212 5 37 71 31 54
Website : www.policycenter.ma

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# How Feasible Is the ECO Currency? A Study of ECOWAS Business Cycles Synchronicity

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## About the Author, Youssef El Jai

Youssef El Jai is a Research Assistant in Economics at the Policy Center for the New South. He joined the think tank in September 2019 after obtaining a Master of Analysis and Policy in Economics from the Paris School of Economics and the Magistère d'Economie at the Sorbonne. He has also taught International Macroeconomics at Paris Dauphine University and held a tutorial in Macroeconomics at Paris Descartes University. He specializes in international economics, business cycle analysis and long-term growth and development issues.

# Abstract

Using a Structural vector auto-regression analysis, this paper attempts to answer the question of the feasibility of a currency union in the Economic community of West African states (ECOWAS). The study focuses on a particular criterion of the theory of optimum currency area (OCA) i.e. the similarity of business cycles. The main results suggest important discrepancies between countries that are already within the WAEMU (CFA Franc) arrangement and countries that have their own arrangement (WAMZ area). In particular, it is possible to distinguish a core and a periphery within the community.

JEL codes: F41, F45, E32

Keywords: Open Macroeconomics, Optimum Currency Area, Business Cycles

# How Feasible Is the ECO Currency? A Study of ECOWAS Business Cycles Synchronicity

## I. Introduction

In 2000, six member countries[1] of the Economic Community of West African States (ECOWAS) decided upon forming a monetary zone, which they called the West African Monetary Zone (WAMZ). The aim of creating such entity was to launch a common currency, the ECO, which would compete against, then merge with the WAEMU's CFA Franc. It was set to start in 2005 but was delayed because some countries failed to match the convergence criteria previously set. The latter covered different areas (soundness of macroeconomic management, debt sustainability, good public governance etc.). Following the great depression, the ECO start was again postponed. In 2009, ECOWAS countries decided to accelerate the process by setting 2020 as the year of the launching of a West African common currency held by a West African Central Bank. In the meanwhile, countries had to stick to the criteria of the monetary union. Successive assessments were however not very reassuring. Indeed, in 2012, there was a great state of divergence among the countries, and the index of convergence that was constructed for the purpose of starting the monetary union, declined by more than 15 percentage points. In 2016, only one country was close to crossing all the boxes. This casts some serious doubts on the feasibility and sustainability of such a currency union. While the authorities of the participating countries are showing a lot of willingness to match the criteria set at the creation of WAMZ, there are some reasons to think that, it is too early for such a union to be formed at this stage. Still, one can also argue that, from an economic perspective, forming a monetary union brings about more discipline on two aspects: first, countries outside of WAEMU (e.g. Nigeria) have a history of high inflation in the recent years and could gain more stability and monetary credibility if the ECO is pegged to the Euro like the CFA franc is today. Second, setting fiscal rules can be a good incentive for a better public management and governance. These arguments do make sense but cannot mask the important disparities between the participating countries, which would require more time to harmonize the structure of ECOWAS. The question remains then to what extent are these countries similar in order to be able to form a currency union?

The starting point of this work relates to general theory of optimum currency areas proposed by Robert Mundell (1961). The latter defined a currency area as an economic region that shares a common currency and within which the exchange rate is fixed. The contribution of Mundell came as an argument in the debate around the optimal exchange rate regime and flexibility as a tool for stabilization. In particular, he insisted on certain aspects of the regional setting that would allow a set of countries to create a currency union. These are business cycles synchronicity, factor mobility, price and wage flexibility and the presence of a risk-sharing mechanism that would allow for compensation in case of an asymmetric shock.

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1. Nigeria, Ghana, Guinea, Sierra Leone, Liberia, The Gambia

Coming to Africa, there has been extensive work on the feasibility of monetary unions in the continent. Given the history of high inflation incurred by some African countries, establishing a monetary union can be an effective way to bring about some monetary policy credibility. In their work on the cost and benefits of such unions in Africa, Debrun et al. (2010) do a CBA by relying on a theoretical model. They find that although, from a business cycles perspective, countries in potential monetary unions in Africa have a lot of asymmetries in response to shocks, the benefits in terms of monetary stability of joining those currency unions offset the losses that are due to the incompatibility of union and national policies. Bayoumi and Ostry (1997) rely on a VAR analysis of shock asymmetry to assess the state of potential currency unions in Sub-Saharan Africa. Their methodology, which does not lie on solid theoretical grounds, is based on a study of shocks to GDP. They compare the correlation of shocks to that of Germany, Japan and the US and find a lower correlation between African countries, concluding that a monetary union would not be appropriate. Fielding and Shields (2001) use the same methodology with a four-variables VAR model, based on a theoretical model of a small open economy to study the similarity of business cycles across the two CFA franc zones. They find strong evidence of high correlation of price shocks both inside and within the two zones. Cushing & Harvey (2014) build a three-variables VAR model identified à la Blanchard and Quah (1989) to study the feasibility of a monetary union in the WAMZ area. They do not find evidence for a common source of shocks and asymmetry of responses to common shocks, concluding that there is no strong foundation for forming a currency union. Ekong and Onye (2012) use the same methodology with four variables adding external shocks. They find high asymmetry within the Western African countries in their sample. In another strand of the literature, Carton et al.(2010) build a two-country DSGE model calibrated for Nigeria and WAEMU to study the effect of commodity-prices shocks in ECOWAS. They compare three different exchange rate regimes (flexible with constant money supply, flexible with accommodating money supply and fixed-rate). They find that a big oil-exporter like Nigeria is better off under a flexible regime while WAEMU behaves better under a fixed-exchange rate regime. They propose the creation of an oil fund (a transfer mechanism) to induce the right compensations between the winners and losers in case of an asymmetric shock. Benassy and Coupet (2005) use cluster analysis to assess the appropriate boundaries for a monetary union in the CFA zone and ECOWAS. They find evidence for a divergence within the CFA zone and distinguish a core within WAEMU based on some macroeconomic and trade fundamentals criteria. In particular, they recommend extending the latter union to Sierra Leone, The Gambia and Ghana rather than running a full-fledged monetary union with a relatively large country such as Nigeria. Qureshi & Tsangarides (2008) also use cluster analysis to assess the feasibility of a currency union in ECOWAS. Their results reveal important asymmetries between WAEMU countries and the WAMZ area. Within the latter, Ghana and Nigeria form a distinct cluster, which draws some doubts about the relevance of the two countries within a future union. Other studies rely on an assessment of fiscal discipline and macroeconomic performance to answer the question of a currency union in Western Africa. Devarajan and de Melo (1987) show that on average CFA zone countries behave much better than the rest of West African countries in real terms but exchange rate misalignments constitute a major obstacle to higher growth. This result confirms the conclusions of Guillaumont (1984). In the 2016 report of ECOWAS' economic convergence, only one country met all the macroeconomic indicators soundness criteria. As of policy tools convergence, there is no clear evidence of a harmonization of these among the ECOWAS area. This draws some serious doubts about the move toward further economic integration in the form of monetary unification. In a work closely related to our research question, although not directly related to the OCA theory, Jidoud (2012) studies the sources of business cycles fluctuations in a typical Sub-Saharan country (Ivory Coast) using a DSGE model. He finds that his benchmark economy is mainly affected by productivity and world interest rates shocks. This explains most of the poor performance in Sub-Saharan Africa.

This paper tries to answer the question set above about the similarity of business cycles across ECOWAS countries. For that purpose, the main interest is looking at how the different countries respond when a macroeconomic shock occurs using a structural vector auto-regression model (SVAR). I take a general perspective by looking at the whole economic community rather than focusing on a particular zone within it, as it has been done before (e.g. Cushing & Harvey 2014). To my knowledge, there is no published work that considers this research question in the same manner. By doing so, I also contribute to the literature on the sources of fluctuations of the real exchange rates in Sub-Saharan Africa. In particular, my results confirm those of Adom et al. (2012), who find that demand shocks are the main driver of the real exchange rates in those countries. Also, in line with Houssa (2008), I find that output is mainly driven by supply-side shocks. Moreover, it is possible to distinguish a core, that consists of WAEMU countries, and a periphery within ECOWAS.

Section 2 will discuss the methodology in light of the previous literature on the subject. Section 3 will present the data and give some insights about selected macroeconomic indicators of ECOWAS countries. Section 4 is dedicated to the discussion of the econometric results and section 5 concludes.

# II. Methodology

This paper relies on Vector Autoregression (VAR) modelling, as done in previous work by Bayoumi & Eichengreen (1993, 2017). They study the synchronicity of Western European business cycles using a structural Vector autoregressive model with output and inflation to assess whether the euro area is an optimum currency area. Their identification scheme follows Blanchard and Quah's (1989) long-run identification scheme, that restricts demand shocks to have only temporary effects. Clarida & Gali (1994) extend the latter work to an open economy framework, with three variables (output, the real exchange rate and prices) to study the main sources of fluctuations in the real exchange rates in advanced economies.

My work borrows from both methodologies by (1) taking a SVAR model, to answer a similar question to the one considered by the first authors, although not evolving around the same region. (2) I extend their model by taking three variables, adding the real exchange rate, in the same spirit as the second paper. By doing so, I can better capture the dynamics of the business cycles in this area, in which the difference of the current monetary arrangements can be a determinant of the real exchange rate response to aggregate shocks.

All variables are taken in their natural logarithm form. Output is measured by GDP of each country in our sample. Prices are proxied by the GDP deflator. The real exchange rate is built as follows:

$$q_t = e_t + p_t^{US} - p_t^i$$

where q is the bilateral real exchange rate, e is the bilateral exchange rate between the local currency of the considered country and the US dollar (1 $ = X LCU), $p^{US}$ is the CPI in the US and $p^i$ is the price in country i, where i represents every ECOWAS country in the sample. According to this definition, an increase in the real exchange rate corresponds to a real depreciation of the local currency. The choice of the US is motivated by the fact that part of the sample (WAEMU) is pegged to the Euro and therefore that might reduce the sources of variability in the real exchange rate for those countries. Also, the

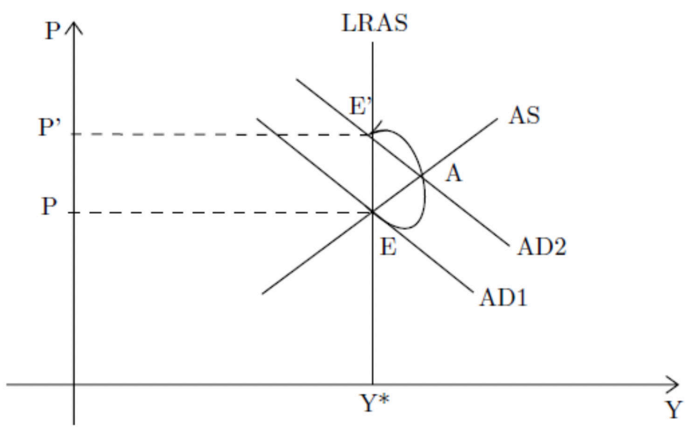
American dollar is the international reserve currency, and therefore seemed as a natural choice for this analysis.

Furthermore, every country-model incorporates three types of shocks that can be classified in two categories. On the one hand, real shocks in the form of aggregate supply and aggregate demand shocks and on the other hand a nominal shock. The difference between these shocks lies in the assumption that will be made for identification as it is expected that nominal shocks have long run effects solely on prices in the long run. Shocks to the GDP growth rate are chosen as supply shocks because it has been shown that this is the main driver of output fluctuations in developing countries (e.g. see Rand & Tarp 2002, Hoffmaister 2001). Also, an important strand of the literature insists on the importance of terms-of-trade as a driving factor of supply in developing countries (e.g. Hoffmaister et al. 1997, Broda & Tille 2003, Kose 2001 and 2002). Therefore, one can interpret the supply shocks as mainly driven by the ToT, which requires them to have long run effects on the real exchange rate and output. Shocks to the change in the real exchange rate are aligned as aggregate (relative) demand shocks because most of the countries in my sample are considered to be import-dependent, especially when it comes to some primary (manufactured) goods (UNCTAD report 2016). Shocks to inflation are restricted to be nominal shocks that only have temporary effects due to short-term price stickiness. In the long run, we assume that money is neutral.

I present the underlying theoretical conjectures in an AS-AD framework.

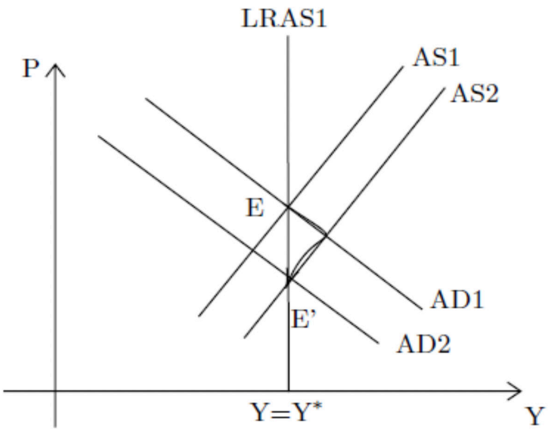
- Consider the case of a nominal shock: we would expect a transitory increase of output and a permanent increase in prices. Graphically, this corresponds to a translation of the AD curve to the right. In the short-run the economy is above its potential (point A) then it converges back to its potential (point E').

**Figure 1: Nominal Shock**



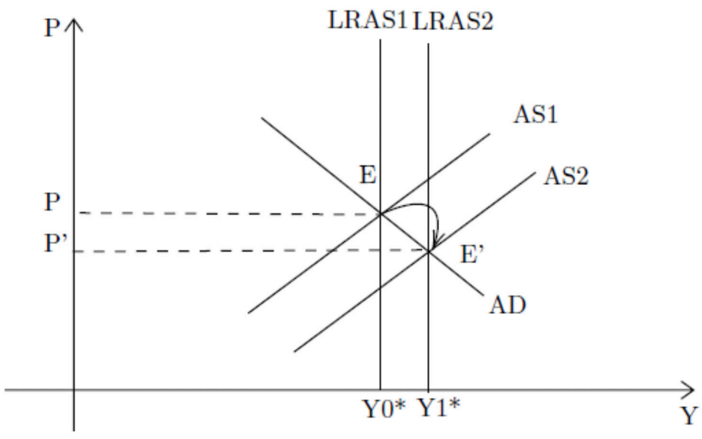

- Consider the case of an aggregate demand shock, through a real appreciation of the exchange rate. All else being equal, one would expect prices to decrease as a result of lower import prices, triggering an increase of demand for foreign goods, and on the other hand, foreign demand decreases due to a loss in price-competitiveness of exports, if the condition of Marshall-Lerner holds, this translates in a decrease of exports and an increase of imports. On the supply side, imported disinflation translates into a movement to the right of the AS curve. The new equilibrium is established in E'.

**Figure 2: Aggregate Demand Shock**




- Consider the case of a positive supply shock, all else being equal, one would expect a permanent increase in output, a permanent decrease in prices and a depreciation of the real exchange rate resulting in a better trade balance and a higher output level (consistent with a J-Curve pattern).

**Figure 3: Aggregate Supply (ToT) Shocks**




This sets the theoretical foundations of the identification scheme that will be adopted in section

# III. Data

The data for this study are taken for IMF's World Economic Outlook database in its April 2019 version, for real GDP and GDP deflator and the Consumer price index. Data on the nominal exchange rate is taken from World Bank's statistics database. The sample runs from 1980 to 2017. The countries retained for the study are the 8 countries of the WAEMU (Union économique et monétaire de Ouest

Afrique) and 4 countries in the West African Monetary Zone (Nigeria, Sierra Leone, Ghana, Gambia). Cabo Verde and Guinea are not taken into account due to lack of reliable data.

## 1.Descriptive statistics

### 1.1. Gross correlations

| Correlation - RER | | Correlation - GDP | | Correlation-Prices | |
|---|---|---|---|---|---|
| | **Côte d'ivoire** | | **Côte d'ivoire** | | **Côte d'ivoire** |
| Côte d'ivoire | 1.000000 | Côte d'ivoire | 1.000000 | Côte d'ivoire | 1.000000 |
| | ----- | | ----- | | ----- |
| Benin | 0.938504 | Bénin | 0.275438803 | Bénin | 0.772699 |
| | 0.0000 | | 0.0989 | | 0.0000 |
| Burkina Faso | 0.875578 | Burkina Faso | -0.137390 | Burkina Faso | 0.551816 |
| | 0.0000 | | 0.4174 | | 0.0004 |
| Guinée Bissau | -0.298859 | Guinée-Bissau | -0.074710 | Guinée-Bissau | -0.096457 |
| | 0.0684 | | 0.6603 | | 0.5701 |
| Mali | 0.82348755 | Mali | 0.066850 | Mali | 0.709489 |
| | 0.0000 | | 0.6942 | | 0.0000 |
| Niger | 0.796024 | Niger | 0.396214 | Niger | 0.835608 |
| | 0.0000 | | 0.0152 | | 0.0000 |
| Senegal | 0.837803 | Sénégal | 0.420766 | Sénégal | 0.819492 |
| | 0.0000 | | 0.0095 | | 0.0000 |
| Togo | 0.918025 | Togo | 0.227871 | Togo | 0.701890 |
| | 0.0000 | | 0.1750 | | 0.0000 |
| Nigeria | 0.044969 | Nigeria | -0.015741 | Nigeria | 0.151782 |
| | 0.7886 | | 0.9263 | | 0.3698 |
| Gambia | 0.343127 | Gambia | 0.046307 | Gambia | -0.188402 |
| | 0.0349 | | 0.7855 | | 0.2641 |
| Sierra Leone | 0.112382 | Sierra Leone | -0.215685 | Sierra Leone | -0.212971 |
| | 0.5017 | | 0.1998 | | 0.2057 |
| Ghana | 0.347938 | Ghana | 0.029475 | Ghana | 0.156111 |
| | 0.0323 | | 0.8625 | | 0.3562 |

### 1.2 Evolution of intra-regional trade

Figures 4 and 5 in the Appendix: Intra-regional trade is characterized, for the anchor WAEMU country, Ivory Coast, is characterized by its weakness. In particular, the country exports go mainly outside of the economic community. Between 2000 and 2017, the part of Ivorian exports in the region did not go beyond 30%. On the imports side, Nigeria is the main partner of Ivory Coast as it is the main oil-provider in the region. This creates a clear energy dependency. More importantly, supply and demand shocks in those countries might be possibly in case of an adverse shock.

### 1.2 Debt levels

Countries in this part of Sub-Saharan Africa have suffered from unsustainable debt levels in the late 90s and were included in the HIPC initiative jointly led by the IMF and the World Bank. Figure 6 in the appendix show a quite similar pattern of debt levels to GDP with a stable share in the late years around 60 to 70%. The graph shows the gross level of debt. One might wonder to which extent these levels are sustainable. An interesting question to handle is how would forming a currency union enhance a better debt sustainability, but this is out of the scope of our analysis.

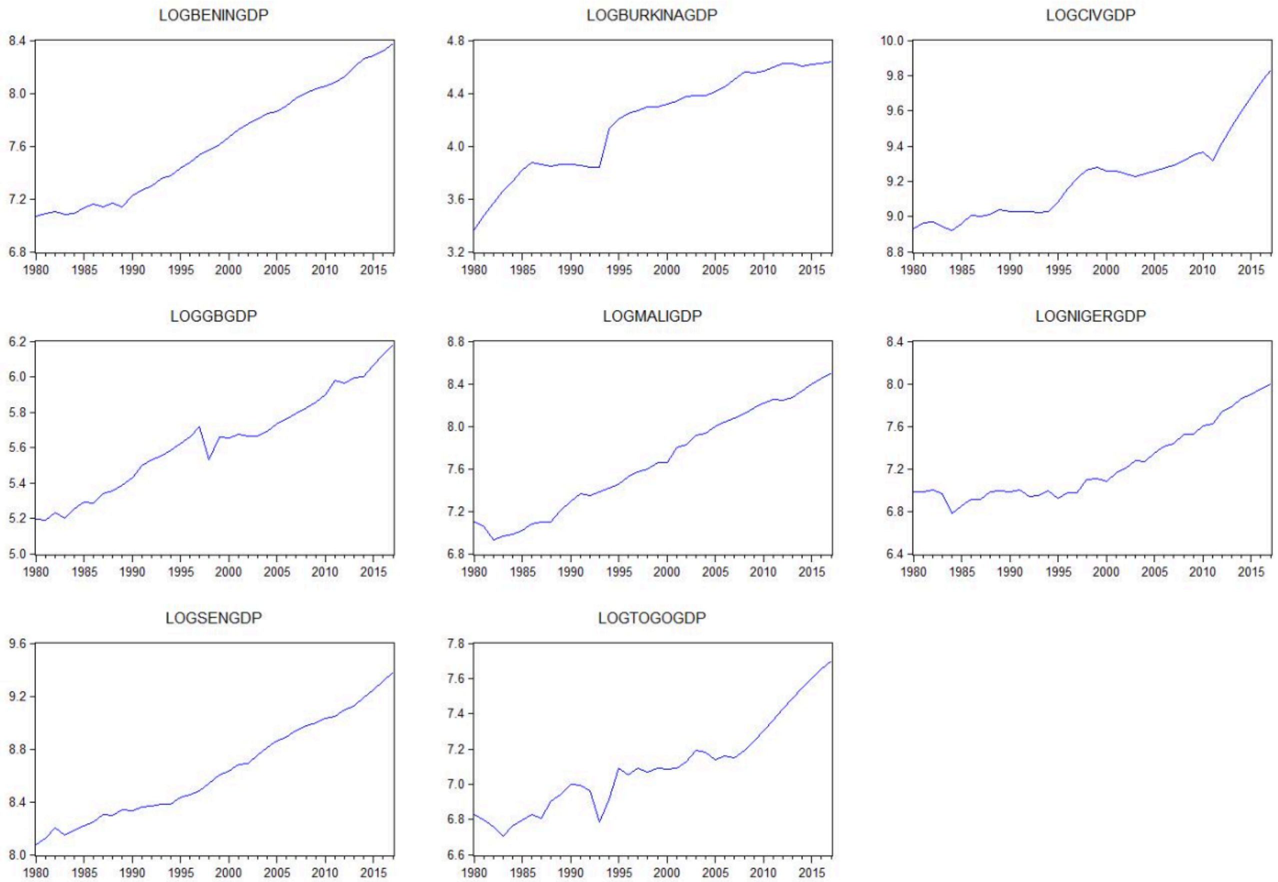
### 1.3 Inflation

Interestingly, when one looks at the inflation rates, WAEMU countries stand out with lower figures. Indeed, one advantage of being in a currency union is a form of price stability that is confirmed in figure 7, where Nigeria, Sierra Leona, Ghana and the Gambia all record higher inflation rates with numbers than can reach two digits. This can give some credit to the rhetoric around the soundness of monetary policy credibility within a currency union. Also, it draws from the fact that the CFA Franc is pegged to the Euro and therefore obeys the same stability objective of 2%.

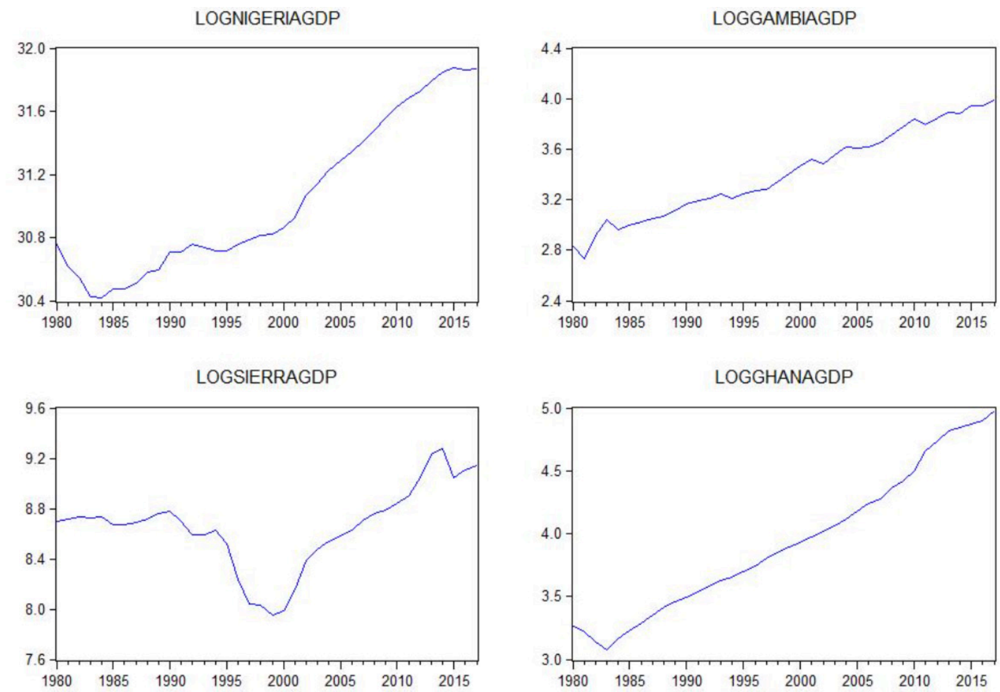
## 2. Plots and unit root tests

Before turning to the results of the unit roots tests, I present the plots of the series in logarithms of GDP, GDP deflator and the real exchange rate for WAEMU countries and the non-WAEMU countries.

### 2.1 GDP

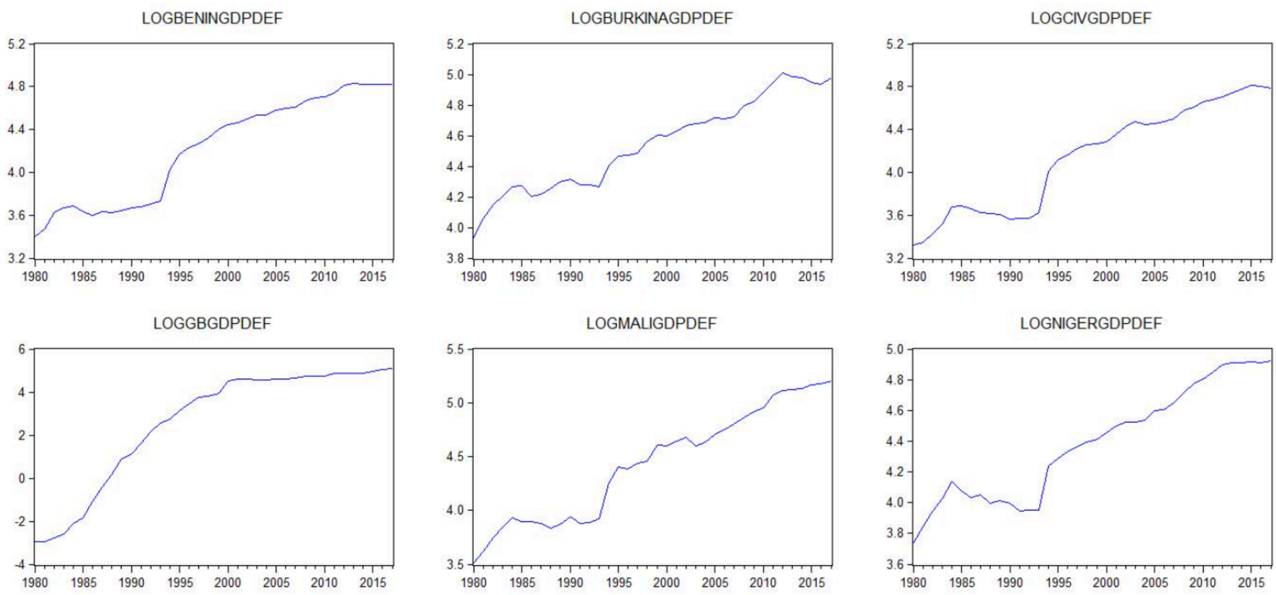


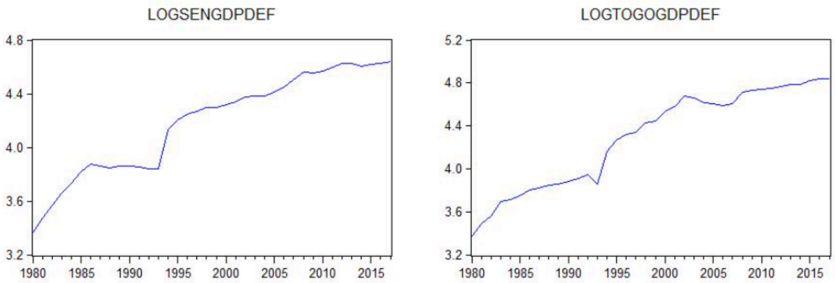
The 8-plotted graphs show some common features, namely the presence of a trend and a structural break in 1994 that coincides with the devaluation of the CFA franc. Specific breaks can also be found and will be controlled for before the econometric analysis (e.g. Civil war in Ivory Coast).



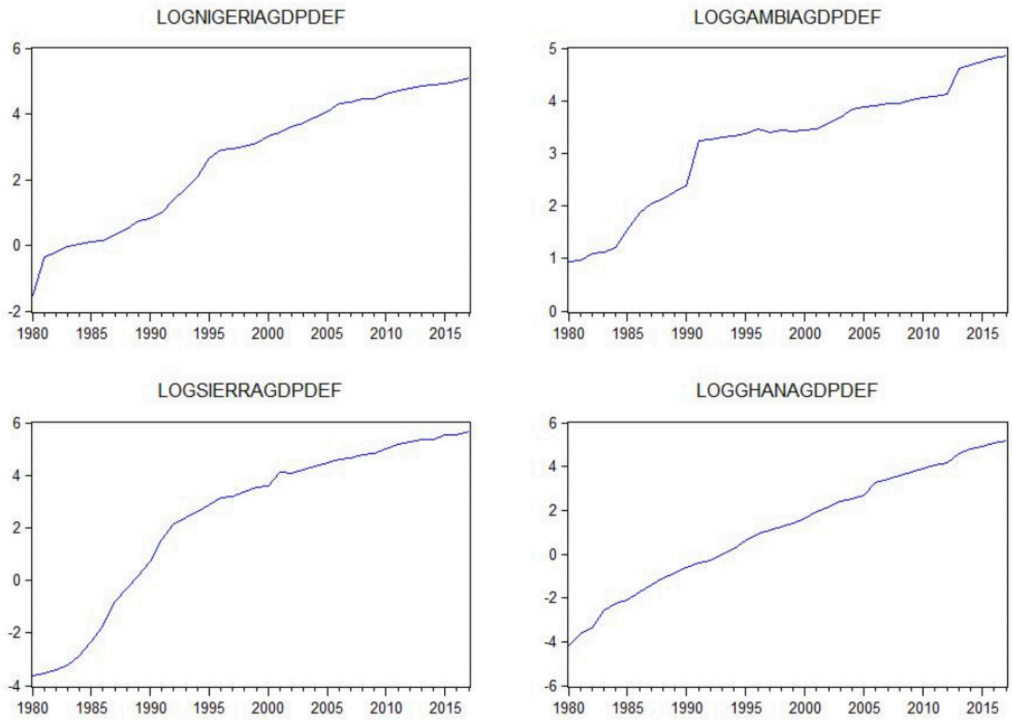

The graphs of the non-WAEMU countries above exhibit the same patterns. The dip in Sierra Leone's GDP corresponds to the period of the Civil war in early 2000s.

### 2.2 GDP Deflator



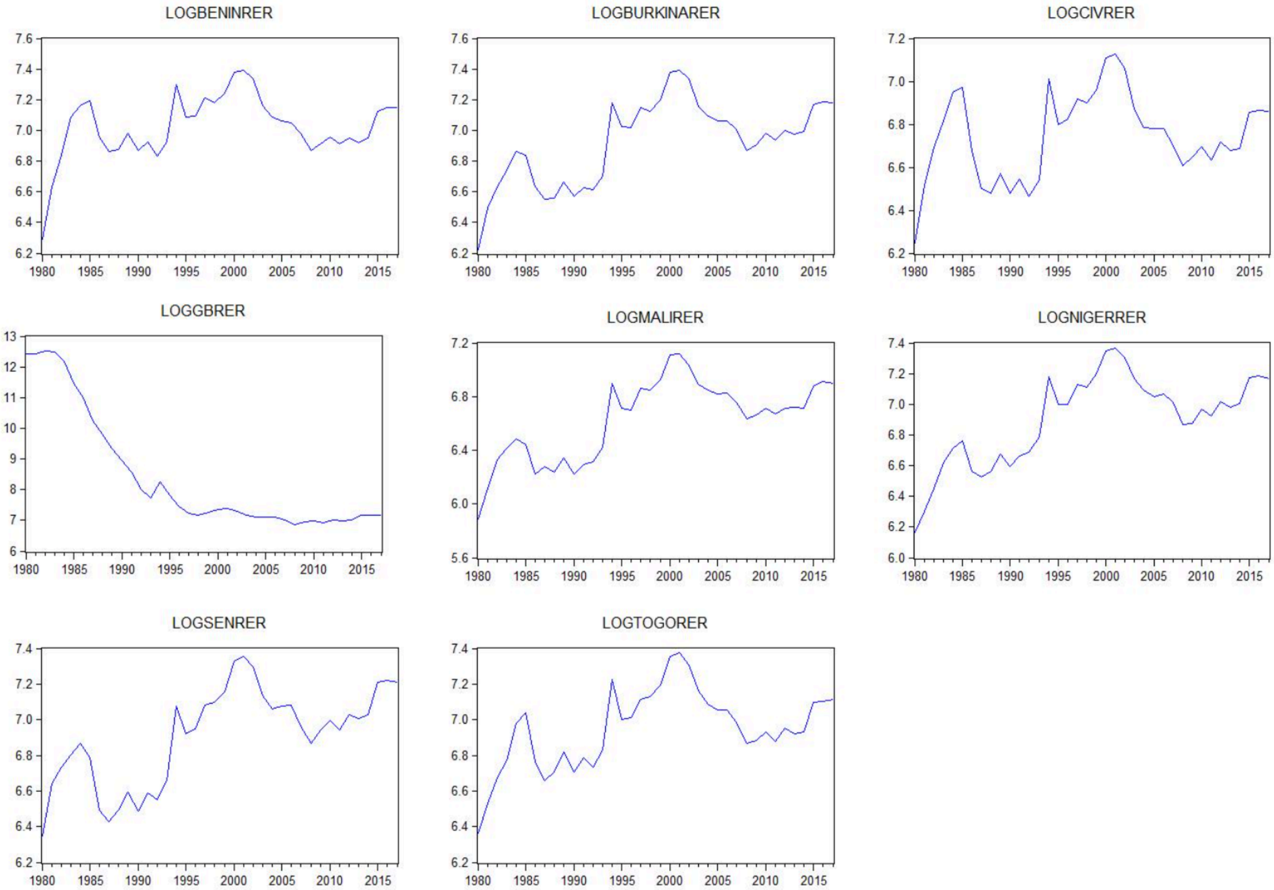



GDP deflator are trending in figures. There is a break in 1994 that corresponds to the devaluation of the CFA franc.




### 2.3 Real exchange rate

The figures below show the evolution of the real exchange rate throughout the period of the sample. The series have a non-stationary appearance without any apparent trend. One interesting feature is the asymmetric shape of the RER of Guinea-Bissau as compared to the other CFA Franc countries. A possible explanation is that this country was the last one to join the WAEMU. As for the breaks, controls are introduced for the devaluation of the CFA franc in 1994 and the appreciation of the Gambian Dalasi. In Ghana, I control for the introduction of a New Cedi in 2007. Sierra Leone, who has a managed floating regime, exhibits a volatile real exchange rate. In Nigeria the appreciation of 1986 coincides with the beginning of a structural reforms program, under the supervision of the IMF. The year of 1999 marks the election of the first civilian president.


LOGBENINRER
LOGBURKINARER
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LOGMALIRER
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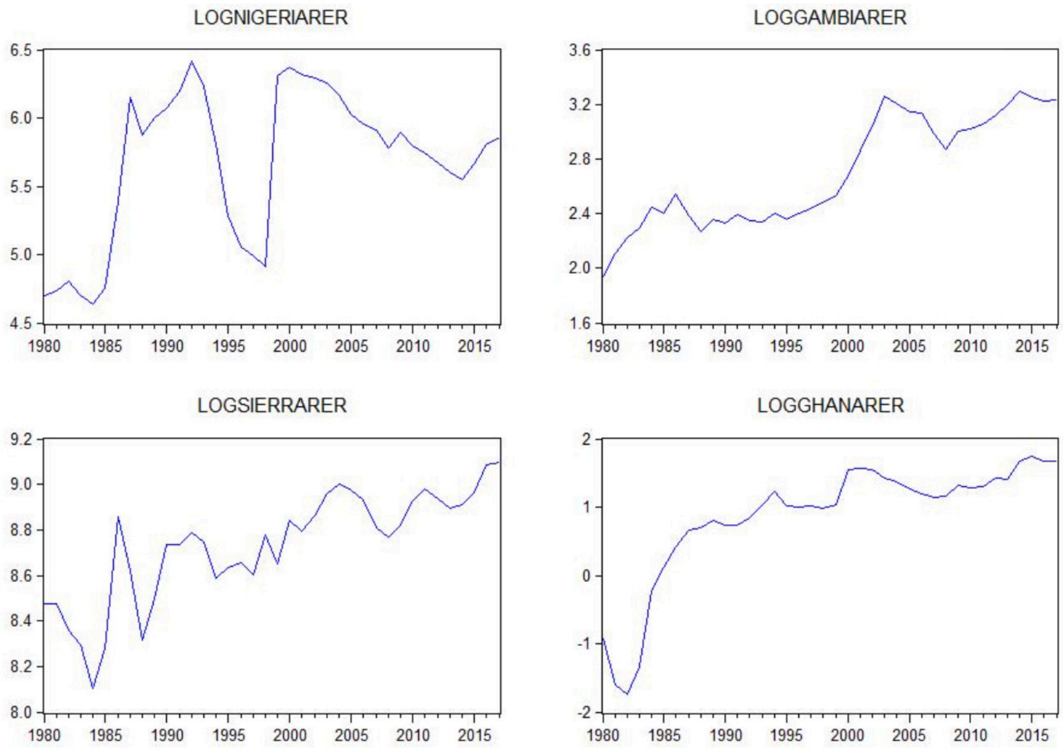

LOGNIGERIARER
LOGGAMBIARER
LOGSIERRARER
LOGGHANARER

## 2.4 Unit root tests

The tables below present the results of the unit root tests on the three variables in logarithms. I use three different test specification (Augmented Dickey-Fuller, Phillips-Perron, Kwiatkowski–Phillips–Schmidt–Shin)[2] taking into account the properties of the series. While the first two test the presence of a unit root as the null hypothesis, the last one has stationarity as a null. The test procedure is presented in length in the Appendix. The rule of decision is set at the 5% level.

| Variable | ADF | PP | KPSS |
|---|---|---|---|
| logbeningdp | I(1) | I(1) | I(2) |
| logburkinagdp | I(1) | I(1) | I(1) |
| logcivgdp | I(1) | I(1) | I(1) |
| loggbgdp | I(1) | I(1) | I(1) |
| logmaligdp | I(1) | I(1) | I(1) |
| Lognigergdp | I(1) | I(1) | I(1) |
| Logsenegalgdp | I(1) | I(1) | I(1) |
| Logtogogdp | I(1) | I(1) | I(1) |
| Lognigeriagdp | I(1) | I(1) | I(1) |
| Loggambiagdp | I(1) | I(1) | I(1) |
| logghanagdp | I(1) | I(1) | I(1) |
| logsierragdp | I(1) | I(1) | I(1) |

| Variable | ADF | PP | KPSS |
|---|---|---|---|
| logbeningdpdef | I(1) | I(1) | I(1) |
| logburkinagdpdef | I(1) | I(1) | I(1) |
| logcivgdpdef | I(1) | I(1) | I(1) |
| loggbgdpdef | I(2) | I(2) | I(2) |
| logmaligdpdef | I(1) | I(1) | I(1) |
| Lognigergdpdef | I(1) | I(1) | I(1) |
| Logsenegalgdpdef | I(1) | I(1) | I(1) |
| Logtogogdpdef | I(1) | I(1) | I(1) |
| Lognigeriagdpdef | I(1) | I(1) | I(1) |
| Loggambiagdpdef | I(1) | I(1) | I(1) |
| logghanagdpdef | I(1) | I(1) | I(1) |
| logsierragdpdef | I(1) | I(1) | I(1) |

2. Taken with a trend and a constant except for the RER

| Variable | ADF | PP | KPSS |
|---|---|---|---|
| logbeningdp | I(1) | I(1) | I(1) |
| logburkinagdp | I(1) | I(1) | I(1) |
| logcivgdp | I(1) | I(1) | I(1) |
| loggbgdp | I(1) | I(1) | I(1) |
| logmaligdp | I(1) | I(1) | I(1) |
| Lognigergdp | I(1) | I(1) | I(1) |
| Logsenegalgdp | I(1) | I(1) | I(1) |
| Logtogogdp | I(1) | I(1) | I(1) |
| Lognigeriagdp | I(1) | I(1) | I(1) |
| Loggambiagdp | I(1) | I(1) | I(1) |
| logghanagdp | I(1) | I(1) | I(1) |
| logsierragdp | I(1) | I(1) | I(1) |

All three variables are integrated of order 1 ($I(1)$). The KPSS test for the logarithm of Benin rejects the hypothesis of stationarity but this is not coherent with the results of ADF and PP. We consider thus the first two tests as more reliable. For Guinea-Bissau, all variables are $I(2)$. This might be problematic for the rest of the analysis. In particular, when comparing the accumulated responses of prices, on the one hand, I would be looking at price levels responses for eleven countries and on the other hand I would only have the response of inflation for Guinea-Bissau and not the price level. As a result, at this stage of the analysis, I decide to drop the country from the sample.

### 2.5 Cointegration tests

Before choosing our methodology, I ran multiple cointegration tests using Johansen cointegration technique to assess whether I could use a non-stationary SVAR model. I have tested a specification that allows for the presence of a linear trend in the VAR model but none in the cointegration equation. For every country in our sample, I fail to identify any cointegration relation. Therefore, I adopt a first-difference stationary specification for all the SVAR models we will run. This result is in line with previous literature about optimum currency areas (e.g. Campos & Macchiarelli 2016; Bayoumi & Eichengreen 1994, 2017).

## IV. Macro-econometric model

In this section, I build the macro-econometric model that will be ran for each country in our sample. The structural form writes:

$$AX_t = \mu + B(L)X_t + \varepsilon_t$$

Where A is an invertible 3x3 matrix of short-run coefficient and $X_t' = (\Delta y_t \ \ \Delta q_t \, \Delta p_t)$. B is a 3x3 matrix of structural coefficients and is a vector of structural shocks such that $\varepsilon' = [\varepsilon^s \, \varepsilon^d \varepsilon^m]$.

Inverting A, we get the following reduced form:

$$X_t = A^{-1}\mu + A^{-1}B(L)X_t + A^{-1}\varepsilon_t$$

Given the stationarity of the variables, we can obtain a Wold decomposition of this model:

$$\left(I - A^{-1}B(L)\right)X_t = A^{-1}\mu + A^{-1}\varepsilon_t$$

which we can denote

$$\left(I - H(L)\right)X_t = a + \eta_t$$

where $\eta$ is the vector of the disturbances corresponding to the reduced form VAR. The wold form thus obtained is:

$$X_t = m + \sum_{j=0}^{\infty} c_j \eta_{t-j}$$

Now suppose the reduced form estimates are given by

$$X_t = \eta_t + C_1\eta_{t-1} + C_2\eta_{t-2} + \dots$$

and the structural estimates given by

$$X_t = D_0\varepsilon_t + D_1\varepsilon_{t-1} + D_2\varepsilon_{t-2} + \dots$$

By identification and using the fact that $\eta_t = A^{-1}\varepsilon_t$ one gets

$$D_0 = A^{-1} \ and \ D_j = C_j D_0 \ for \ \ j > 0$$

## Identification Scheme

To identify the parameters of the model, a set of restrictions is needed.

- Concerning the structural shocks. I assume that these are not correlated. That is, a supply shock is independent from the occurrence of an aggregate demand shock or a nominal shock and vice versa.
- The variance-covariance matrix of the structural shocks is normalized to identity.
- 3 additional restrictions have to be imposed to achieve identification. For that purpose, I rely on an identification à la Blanchard-Quah (1989) in its extended form (Clarida & Gali, 1994) which has been extensively used in that strand of the literature. The methodology is based on a C-Model (Amisano and Giannini, 1997). The theoretical foundations have been presented in section 2 using an AS-AD framework. It states that aggregate demand shocks, that are aligned as shocks to the exchange rate, can only have a temporary effect on output but can affect the exchange rate and prices permanently. Aggregate supply shock can affect the three variables temporarily and permanently. The nominal shocks have only transitory effects on output and the real exchange rate but can affect prices in the long run.

Algebraically, it writes

$$\begin{pmatrix} \Delta y_t \\ \Delta q_t \\ \Delta p_t \end{pmatrix} = \sum_{i=0}^{\infty} L^i \begin{pmatrix} a_{11i} & a_{12i} & a_{13i} \\ a_{21i} & a_{22i} & a_{23i} \\ a_{31i} & a_{32i} & a_{33i} \end{pmatrix} \begin{pmatrix} \varepsilon_t^S \\ \varepsilon_t^D \\ \varepsilon_t^M \end{pmatrix}$$

Given that the nominal shock and the demand shock do not affect output in the long run, one can write

$$\sum_{i=0}^{\infty} a_{12i} = \sum_{i=0}^{\infty} a_{13i} = 0$$

And that the nominal shock does not affect the RER in the long run

$$\sum_{i=0}^{\infty} a_{23i} = 0$$

The matrix of structural coefficients is then given by

$$\sum_{i=0}^{\infty} \begin{pmatrix} c_{11i} & c_{12i} & c_{13i} \\ c_{21i} & c_{22i} & c_{23i} \\ c_{31i} & c_{32i} & c_{33i} \end{pmatrix} \begin{pmatrix} d_{11i} & d_{12i} & d_{13i} \\ d_{21i} & d_{22i} & d_{23i} \\ d_{31i} & d_{32i} & d_{33i} \end{pmatrix} = \begin{pmatrix} . & 0 & 0 \\ . & . & 0 \\ . & . & . \end{pmatrix}$$

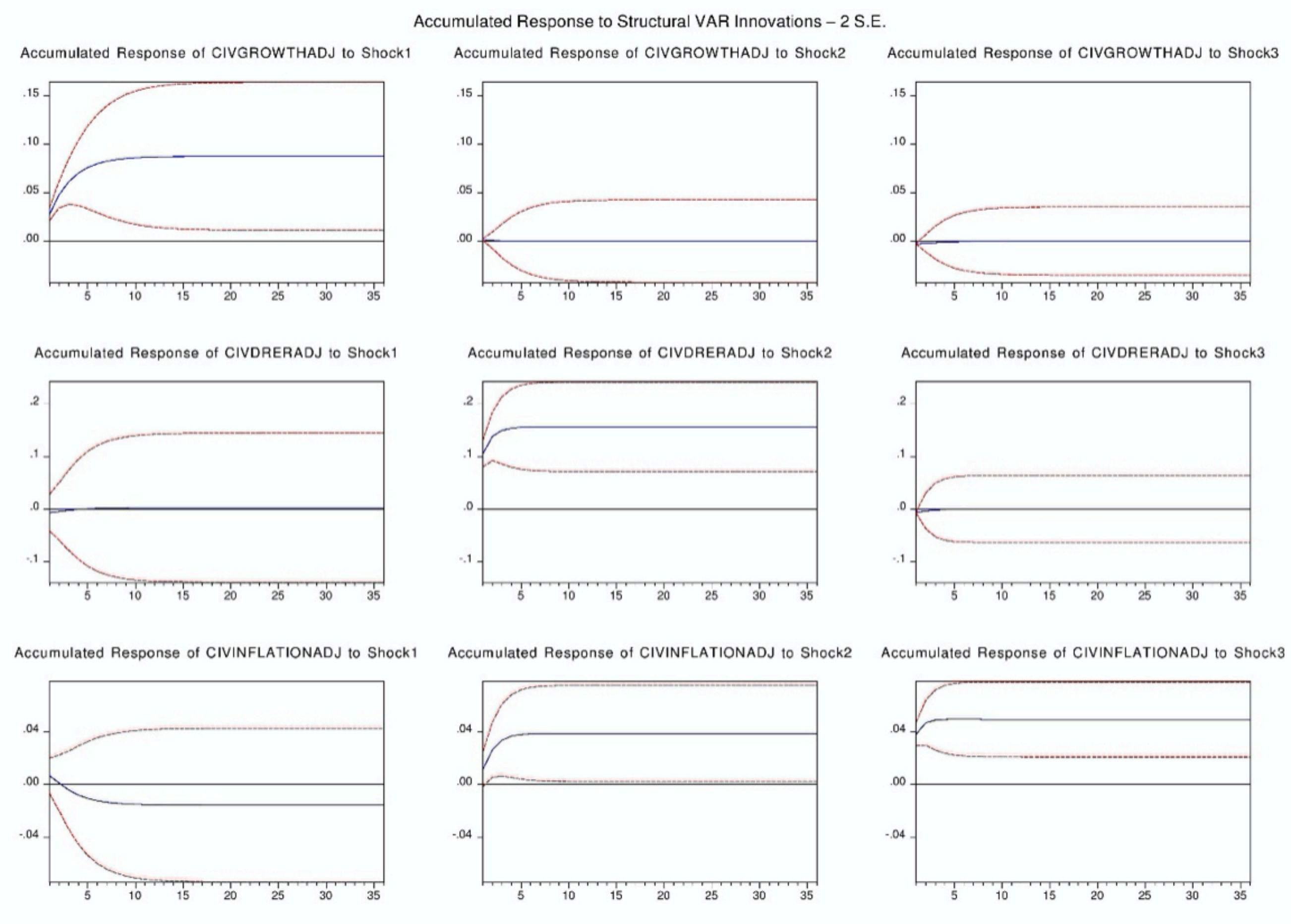
A model of this type is run for every country. While I do not allow shocks to be correlated within each model, I will be interested in the correlation between shocks across the models. Given the setting of WAEMU countries (a monetary union), running the estimation that way can fall short of capturing some cross-effects of certain shocks across the countries. I will be agnostic about that, although this might seem too strong as an assumption. In doing so, I follow the same methodology as the main paper this work is based on where the authors rely on country-by-country estimation rather than going for a PVAR estimation method (Bayoumi & Eichengreen 1993).

# V. Results

I estimate a set of SVAR models of order 1. The latter is chosen following the lag selection criteria (AIC, HQ, FPE, BIC). For some countries, I found a suitable model of order 2. However, to be able to compare the results of the responses and the correlation of the structural shocks, I chose the same order for all the sample.

My analysis focuses on measuring the similarity of the business cycles across the countries in the sample. This will be done on various levels. First, I will look at the responses of levels of GDP, the real exchange rate and prices following the three types of shocks I have in the model and how they compare one to another. Then, I will extract the structural shocks to study their correlation. This exercise requires to choose two anchor countries as a reference (i.e. for which the correlation is «normalized» to one by definition). The two countries I choose are Ivory Coast for WAEMU and Nigeria for non-WAEMU countries. This choice is motivated by the fact that Ivory Coast is, from an economic perspective, the largest economy in the West African CFA zone. Nigeria is chosen because it is considered as the strongest economy in West Africa but also because its presence in the future monetary union has been subject to many debates, due to its relatively large size.

## 1. Impulse responses




I present here the impulse responses of Nigeria and Ivory Coast following the three types of shocks I have identified. The size of the shock corresponds to a one standard deviation. The graphs for the remaining countries are presented in the Appendix.

The figure above gives the responses of Ivory Coast. Shocks 1, 2 and 3 correspond respectively to aggregate supply, aggregate demand and nominal shocks.

Following a one-standard deviation aggregate supply shock, output increases on impact and this increase is significantly sustained in the long run. This is in line with the textbook approach. Indeed, if the economy is hit by a positive aggregate supply shock, the expected outcome is that productivity improves and income increases too. In a stochastic IS-LM setting (Obstfeld extension of Mundell-Fleming-Dornbusch), all things being equal, this can be captured by a right translation of both IS and LM curves. One would expect the real exchange rate to depreciate. However, my results do not exhibit this pattern. The RER barely responds to the supply shock and it is not significant. Concerning prices, the model produces a continuous decrease of prices following a supply shock, coherent with the textbook prediction. However, the response is not significant as the confidence interval crosses the zero line.

Following a one-standard deviation aggregate demand shock, as terms of trade vary, one would expect the real exchange rate to appreciate, prices to decrease permanently (lower import prices), and output to increase in the short run, as specified in our identification. The model almost delivers these predictions. First, output does not react at. The response is very weak and is not significant. A theoretical explanation of that is the case of very elastic demand (Horizontal AD curve). However, this is not realistic and might be due to a figment in the data. The real exchange rate depreciates on impact by 0.1 and even more in the long run. Prices increase permanently as a result of an imported inflation and the response is significant, as one would expect. The pattern described here corresponds then to the case where consumer increase their demand for home goods relative to foreign goods.

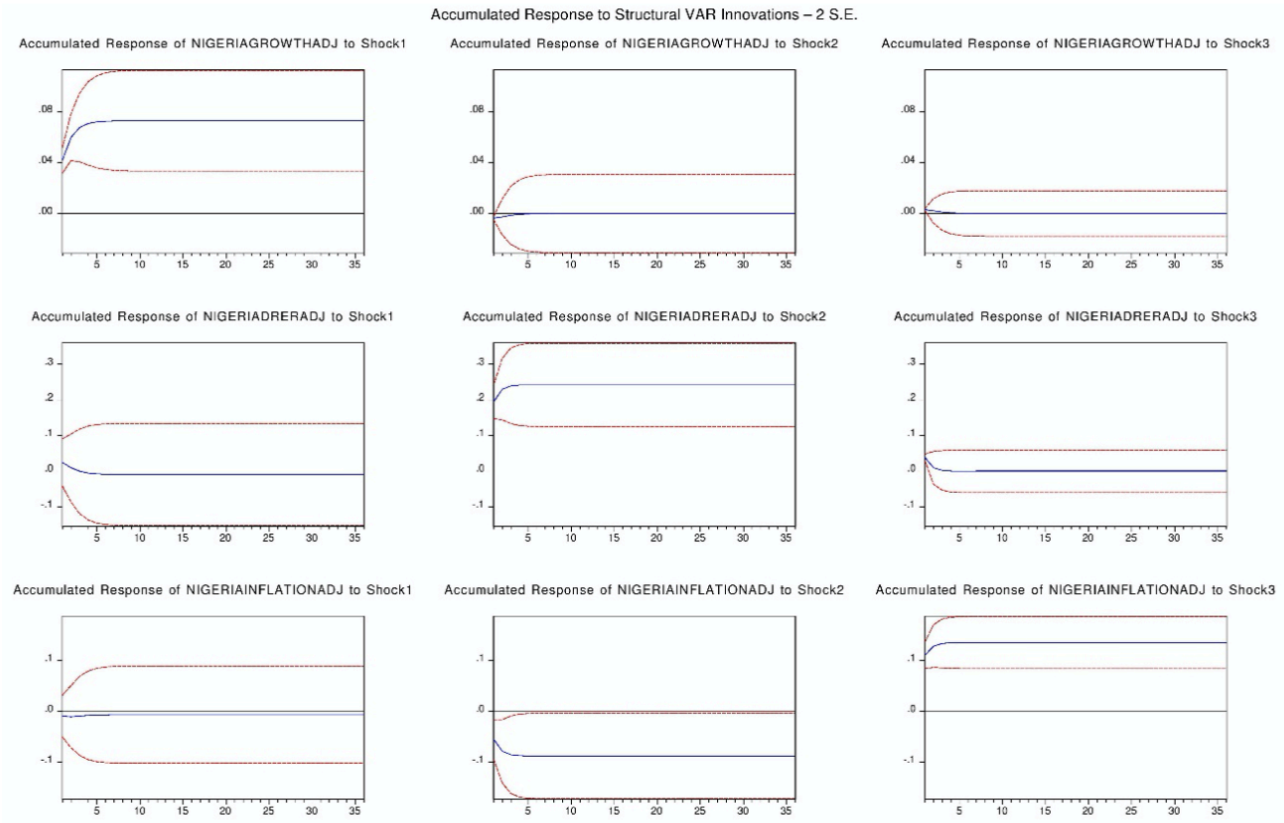
After a one-standard deviation nominal shock, the real exchange rate and the output react as expected varying weakly while prices increase significantly by 0.04. This increase is sustained in the long run.

How does this result compare to the results of the other countries and where does Nigeria fit? First, among WAEMU, some discrepancies can be observed in the responses to the supply shock. As shown in figures 8 to 16, while Mali and Niger behave in the same manner as Ivory Coast, with the same shape of responses. The other countries, namely, Benin, Burkina, Sénégal and Togo show a different pattern after a supply shock. Indeed, when hit, these economies see their prices increase rather than decrease which does not go hand in hand with the textbook prediction. The occurrence of such a result is very rare. Its presence in a large a part of the sample makes it difficult to discard it as an outlier. A possible explanation is that, in response to an aggregate supply shock, with the perspective of a better income, agents react immediately by increasing their demand in a manner that puts pressure on prices and induces inflation. Outside of WAEMU, a pattern that is close to that of Ivory Coast can be observed. Sierra Leone and Ghana exhibit an increase of output both in the short run and the long run. The exchange rate of both countries appreciates (which can be considered as consistent with a Balassa-Samuelson effect) but this effect is not significant. Prices decrease on impact as predicted by the theoretical model but the response weakens in the long run (not significant after three years). The Gambia has the same pattern with the difference of a clear sustained depreciation of the exchange rate and a fall of output in a manner that is consistent with the identification scheme. Indeed, as shown in section 2 output shrinks as a result of deterioration of the trade balance.

Concerning the aggregate demand shock, within WEAMU all countries behave in the same manner as Ivory Coast, except Niger and Sénégal. However, two of them (Mali, Burkina) show non-significant responses of prices both in the short and long run although the sign of the effect is the one to expect form a standard open economy model.

Concerning, Niger, while one would expect prices to decrease as a result of lower import prices, prices increase significantly. In Sénégal, prices decrease on impact but this effect dies out in the long run, contrary to what the theoretical AS-AD model predicted. The real exchange rate depreciates significantly in all countries. For the countries outside WAEMU, Sierra Leone and Ghana exhibit the same responses as Ivory Coast, although with a different magnitude, but not Gambia. Indeed, an aggregate demand shock in Gambia does not affect prices and induces a significant fall of output on impact.

The nominal shock induces different responses for the six other WAEMU countries in the sample. Benin, Togo, Niger, Burkina Faso and Mali share the same effects as Ivory Coast. On impact output falls slightly then goes back to the initial level after one year. The exchange rate appreciates then converges back to its steady state level, with an over-shooting pattern à la Dornbusch. Prices increase steadily and significantly in the long run, as one would expect from the theoretical model. Only Senegal have a different response of the real exchange rate, that depreciates on impact contrary to what one would expect. These results are coherent given that these countries share the same monetary policy and therefore would be expect to react in the same manner to a nominal shock (provided the shock is due to a change in monetary parameters). Ghana shows the exact same pattern as Ivory Coast, while Sierra Leone and the Gambia behave differently. More specifically, in the latter country the exchange rate depreciates significantly on impact then goes back to the steady state. In Sierra Leone, a close pattern to that of Senegal can observed with a non-significant depreciation of the exchange rate instead of a conjectured appreciation.




All these things being said, where does Nigeria responses fit among the set of responses described above? The impulse responses show a very different behavior of output, prices and the exchange rates on two accounts. First, following an aggregate supply shock, prices do not increase permanently as one would expect. The response is weak and not significant both in the short and long run. Then, when it comes to aggregate demand, we have the same responses as Ivory Coast. However, after a nominal shock, we observe a real depreciation and a sustained increase of prices. Also, it is worth noting that the size of the response of output, when significant is much lower. A possible explanation is the presence of a dual exchange rate regime in the country that somehow acts as a shock absorber. After a nominal shock, output does not react while the exchange rate slightly depreciates on impact before dying out. Prices increase significantly and this effect is sustained in the long run.

To sum up, from the results of the responses of GDP and price levels and the exchange rates, one can see that these economies are not completely symmetric from that perspective. In particular, WAEMU countries seem to be hit by relatively more symmetric shocks with the same speed of adjustment.

Countries outside of WAEMU share some of the patterns but not all of them, but also have different paths than the ones observed for Nigeria.

## 2. Correlations

The second step in this analysis is to look at the correlation of the structural shocks across the eleven countries in our sample. This is being done with respect to both Ivory Coast and Nigeria. The study of correlations allows to have an idea about the degree of interdependence between the countries.

| Country | Supply correlation | Demand correlation | Nominal correlation |
|---|---|---|---|
| Benin | 0,2664 | **0,644193** | **0,408524** |
| Burkina Faso | 0,229284 | **0,741982** | **0,125974** |
| Mali | 0,113405 | **0,744343** | **0,325217** |
| Niger | **0,362236** | **0,810104** | **0,529172** |
| Senegal | **0,28149** | **0,832491** | **0,299943** |
| Togo | **0,344175** | **0,931342** | **0,328411** |
| Nigeria | -0,002822 | 0,065373 | 0,031595 |
| Ghana | -0,055518 | 0,247257 | 0,265173 |
| Gambia | -0,034802 | -0,053349 | -0,010783 |
| Sierra Leone | -0,146135 | **-0,474502** | -0,100099 |

Numbers in bold correspond to significant coefficients of correlation.

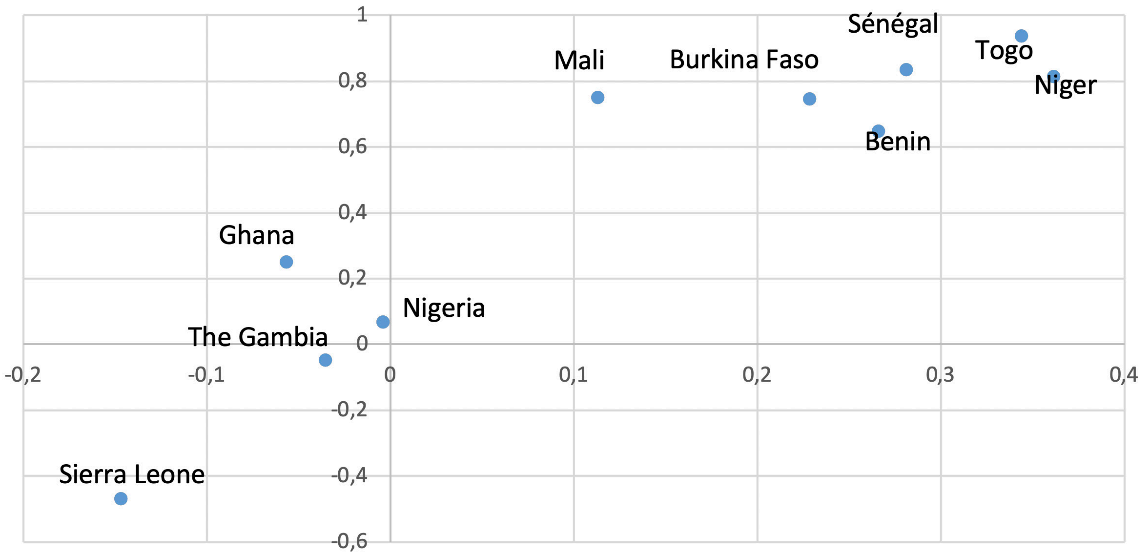
Signficance is based on a T - test with the following t - stat

$$t = \frac{r\sqrt{n-k-1}}{\sqrt{1-r^2}}$$

One important feature of the numbers shown above is the significant correlation of demand shocks within WAEMU. The correlation coefficient ranges from 64% in Benin to 93% in Togo. This result does not however generalize to the other types of shocks. Indeed, when looking at the supply shocks we find significant coefficient of correlation for Niger, Senegal and Togo only. Naturally, as one would expect, there is significant positive correlation of nominal shocks within WAEMU. This makes sense given that it is a monetary union. Burkina Faso stands out as the only WAEMU exception. As for the other countries, the coefficient of correlation computed for the sample period are negative but non-significant.

This provides a first answer to the research question about the feasibility of an extended monetary union within the ECOWAS community. The absence of positive correlation between WAEMU and non-WAEMU countries gives clearly no basis for business cycles synchronicity.

## Correlation of supply (X) and demand (Y) shocks with respect to Ivory Coast



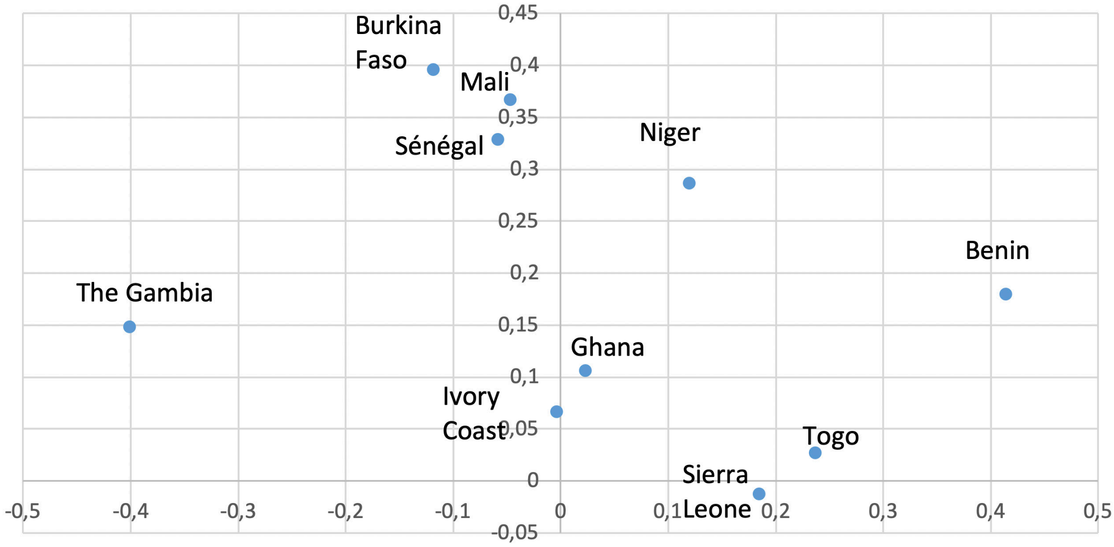

As did Bayoumi & Eichengreen (1993) show for the Euro area, if one restricts the analysis to the supply and demand shocks, a core in ECOWAS can be identified, which basically consists of WAEMU countries that evolve closely to Ivory Coast and a periphery, which consists of the remaining countries. A result that flows naturally from the specific arrangement that prevails in the CFA zone and the criteria it is based upon.

The second part of this exercise is done with respect to Nigeria. The following table gives the correlation coefficient of the structural shocks.

| Country | Supply correlation | Demand correlation | Nominal correlation |
|---|---|---|---|
| Ivory Coast | -0,002822 | 0,065373 | 0,031595 |
| Benin | **0,415377** | 0,178388 | 0,263674 |
| Burkina Faso | -0,117583 | **0,395027** | 0,003353 |
| Mali | -0,045608 | **0,365384** | -0,006606 |
| Niger | 0,121244 | 0,285083 | 0,094839 |
| Senegal | -0,056934 | **0,327722** | 0,192623 |
| Togo | 0,238417 | 0,026502 | 0,209043 |
| Ghana | 0,023924 | 0,105647 | 0,232752 |
| Gambia | **-0,400275** | 0,147326 | -0,172581 |
| Sierra Leone | 0,185847 | -0,012976 | 0,191227 |

The results of the correlations show that there is little correlation of shocks of the ten countries with respect to Nigeria. When it comes to supply shocks, Benin is the only WAEMU country that has significantly positively correlated supply shocks to that of Nigeria. On the demand size, one can say the same about Senegal. The Gambia exhibits strong negative correlation of aggregate supply shocks. Also, it is worth noting that the nominal shocks are not correlated at all across the countries. This implies that there is a possible disconnection of monetary policies in Nigeria and in the other countries and gives further evidence on the asymmetry of the structure of these economies.

**Correlation of supply (X) and demand (Y) shocks with respect to Nigeria**




This result is confirmed by the above plot. While before, one could distinguish between a core and a periphery, there is no apparent pattern as the points are dispersed all over the (X,Y) plane.

## 3. Variance decomposition[3]

This measure provides the main sources of variation in growth, inflation and the change of the real exchange rate across different horizons. Technically speaking, it measures how much each structural shock contributes to the forecast error variance of each variable in the stationary SVAR model, for each country. Formally, the h-step ahead forecast of the vector of endogenous variables can be written as,

$$X_{t+h|t} = \sum_{k=1}^{p} A_p X_{t+h-k|t}$$

For $j \geq 0$, the process $X_{t-j}$ is observed, therefore the forecast error can be written as,

$$X_{t+h} - X_{t+h|t} = \eta_{t+h} + \sum_{i=1}^{h-1} \phi_i \eta_{t+h-i}$$

Given the white noise property of the model, this follows a distribution with zero mean and a variance-covariance matrix

$$\Sigma_h = \Sigma_\eta + \textstyle\sum_{i=1}^{h-1} \phi_i \Sigma_\eta \phi_i{}'.$$

Using the relation between the reduced-form residuals and the structural shocks. Given, the identification of $D_0$ (in particular orthogonality of shocks), one can write the variance-covariance matrix as $\Sigma_\eta = D_0 D_0{}'$. Let each element in $D_0$ be denoted as $\theta_{nm,j}$ where j corresponds to the type

3. The algebra follows the notation of Helmut Lütkepohl and Jean Imbs Macreconometrics courses

of the shocks and n and m the order of rows and columns, the forecast error of the $k_{th}$ element can be written as

$$\sigma_k(h)^2 = \sum_{i=1}^{h-1}(\theta_{k1,j}^2 + \cdots + \theta_{kK,j}^2) = \sum_{h=1}^{K}(\theta_{k1,0}^2 + \cdots + \theta_{kj,h-1}^2)$$

Therefore, the contribution of the shock j to the h-step forecast error variance can be denoted as

$$\frac{\theta_{k1,0}^2 + \ldots + \theta_{kj,h-1}^2}{\sigma_k(h)^2}$$

This describes the underlying algebra of the tables presented in the appendix. The first column in each table corresponds to the forecast error standard error i.e. $\sigma_k(h)$ where k is respectively GDP growth rate, the change in the RER and inflation. The second column gives the proportion of the standard deviation explained by the supply shock. The third column gives the same measure with respect to the aggregate demand shock, while the last column relates to the nominal shock.

The analysis will proceed in the same way as it has been done for impulse responses. The focus will be put on Ivory Coast first then the latter will be compared to WAEMU and non-WAEMU countries as well as to Nigeria. Due to excessive length, the tables will be presented in the appendix.

The results of the decomposition show that the main source of variability in output growth in Ivory Coast is due to supply shocks, with a proportion that exceeds 99%. The real exchange rates fluctuate mainly due to demand shocks with the same 99% proportion. In the short run, one forecast-year ahead, inflation varies mainly due to demand shocks, after 2 years the contribution of the aggregate demand shocks grows to 17% while that of the nominal shock decrease to 78%. Over the long run, inflation is mainly explained by aggregate demand shocks (up to 20%) and nominal shocks (up to 74%), the rest being explained by the supply shocks.

One important aspect of the results is that we verify that supply shocks are the main driver in the variation of growth for all countries, except for Burkina Faso. The proportion of such a shock varies between 77% three periods ahead to 99%, as observed in Ivory Coast. Burkina Faso, a WAEMU country, stands out as the only country in which growth is influenced both by supply shocks (around 70%) and demand shocks (around 25-26%) both in the short and long run.

When it comes to the change in the real exchange rate, the sources of variability do not all compare to the results for Ivory Coast. Indeed, in some countries, e.g. Senegal, the variability in the forecast error stems from a mix of demand shocks and nominal shocks, while in some other countries the exchange rate forecast error variance is driven by demand and supply shocks (e.g. Ghana). Ghana and Benin stand out as the countries where the three shocks affect the change in the real exchange rate, with a higher proportion for demand shocks and supply shocks. Mali and Togo show a similar pattern as the one in Ivory Coast and Niger is the only WAEMU country where the exchange rate is mainly driven by nominal shocks.

Finally, inflation is driven both by nominal shocks (up to 89% in the long run) and shocks in Gambia and some WAEMU countries (Togo, Benin, Mali). In Niger, inflation varies strongly under nominal shocks with a proportion around 78 % after 3 forecast-years ahead, and an increasing share of variability due to aggregate demand shocks. In countries outside WAEMU, inflation varies under the effect of supply and demand shocks (Ghana), demand and nominal shocks (Sierra Leone) and nominal shocks only in Gambia.

So Where does Nigeria fit? In the same way as the other countries, with the exception of Burkina Faso, growth is mainly driven by supply shocks in Nigeria. This result is not surprising given the status of an oil-exporter of Nigeria, which implies an important dependency on oil production and pricing. Looking at the exchange rate, we find that it is mainly driven by demand shocks (unlike Ivory Coast, up to 80% of forecast error variance after three years). Inflation is driven mainly by nominal shocks with a proportion of 98% both in the short and long horizons.

To sum up, output is the only variable that has common sources of variability in all countries except for Burkina Faso. The real exchange rate and prices are driven by different sources from a group of countries to another. This casts doubts about the similarity of business cycles in ECOWAS area. Indeed, if the structures of these economies and their economic activity behavior were the same, the main variables of the respective countries' models should react in the same way and be affected by the same shocks.

## VI. Conclusion and Discussion

In this exercise, I tried to answer a simple question about the feasibility of a monetary union in ECOWAS according to a business cycles synchronization criterion. I followed a well-documented methodology by applying a structural vector autoregressive model to study the synchronicity of business cycles and assess the degree of symmetry of shocks in the concerned countries. My findings confirm the results of previous work on monetary arrangements in West Africa (Bayoumi & Ostry 1997, Cushing & Harvey 2016) and cast some doubt on the feasibility of the union that it set to start in 2020. In particular, I find that there is an important asymmetry of response to aggregate supply and aggregate demand shocks between WAEMU countries and non-WAEMU countries and within WAEMU itself to some extent. The study of the correlation of shocks across the countries gives further evidence on the current non-feasibility of that project. Also, from the sole business cycles synchronization criterion of the OCA theory, the West African CFA Franc Zone appears to be relatively optimal. Countries in WAEMU tend to behave in the same manner following a shock and share the same sources of fluctuations of the business cycles. This, however, does not mean that the current arrangement, as it prevails is workable and sustainable. Suitable reforms, of which the announced changes by Presidents Ouattara and Macron are a step toward a better monetary zone should be a top priority and need to be implemented as soon as possible. Moreover, while the project of a common currency in ECOWAS should remain as a top-priority objective to aim for, our findings together with previous empirical evidence suggests that «Wait and see (and reform)» is the best strategy at the moment. Countries should work on ensuring a minimum of real convergence of their business cycles before fully integrating. Joint productive initiatives as well as the creation of a convergence fund can be a good start to ensure the catch-up. In particular, working on strengthening trade linkages is essential as one the advantages of adopting a common currency is decreasing the transaction costs related to trade.

One important aspect, which is out of the scope of our analysis, is regional political and social instability. While, these countries draw from the European experience to show their ability to form a monetary union, one can argue that these two experiences are very different in many regards. In particular, the creation of the Eurozone, was the result of a gradual and relatively well-prepared process that took many decades. Also, it can be seen as one of the main consecration of long lasting reign of peace within the region. From the West African perspective, one can legitimately be preoccupied about the war against extremism in the Sahel and the political regime instability in some countries which impose an important contingent risk for the sustainability of such a project if it were to be done.

All of that being said, our analysis does not come without shortcomings. On many aspects, it has to be considered incomplete as we only focus on a particular aspect of the theory of optimum currency area. It leaves space for a more global study that focuses simultaneously on all the criteria as a future avenue for research. Also, one can legitimately argue about the proposed methodology and its validity. Perhaps a relying on a PVAR estimation can give better results. Furthermore, due to the status of small open economies that some of the countries in the sample bear, one might argue whether the model is complete without a proper endogenous variable that captures external shocks, such as the world output.

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# VII. Appendix

## 1. Descriptive statistics

### Evolution of intra-regional trade

**Figure 4: Exports**

Evolution of intra-ECOWAS exports of Ivory Coast

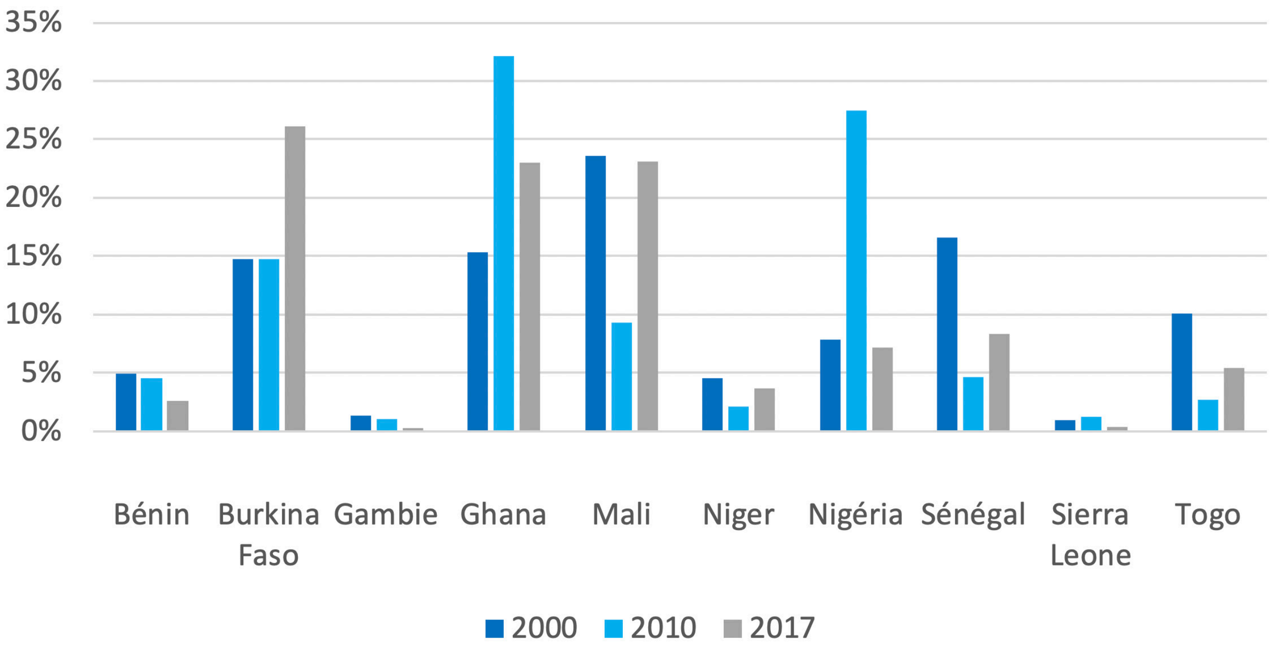
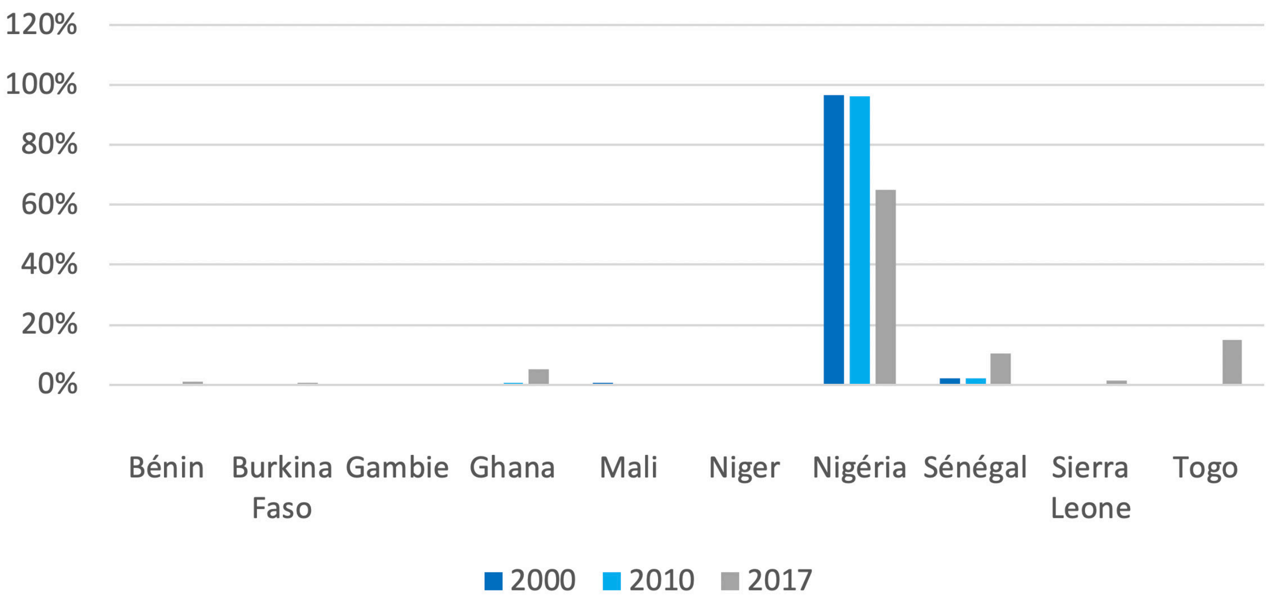


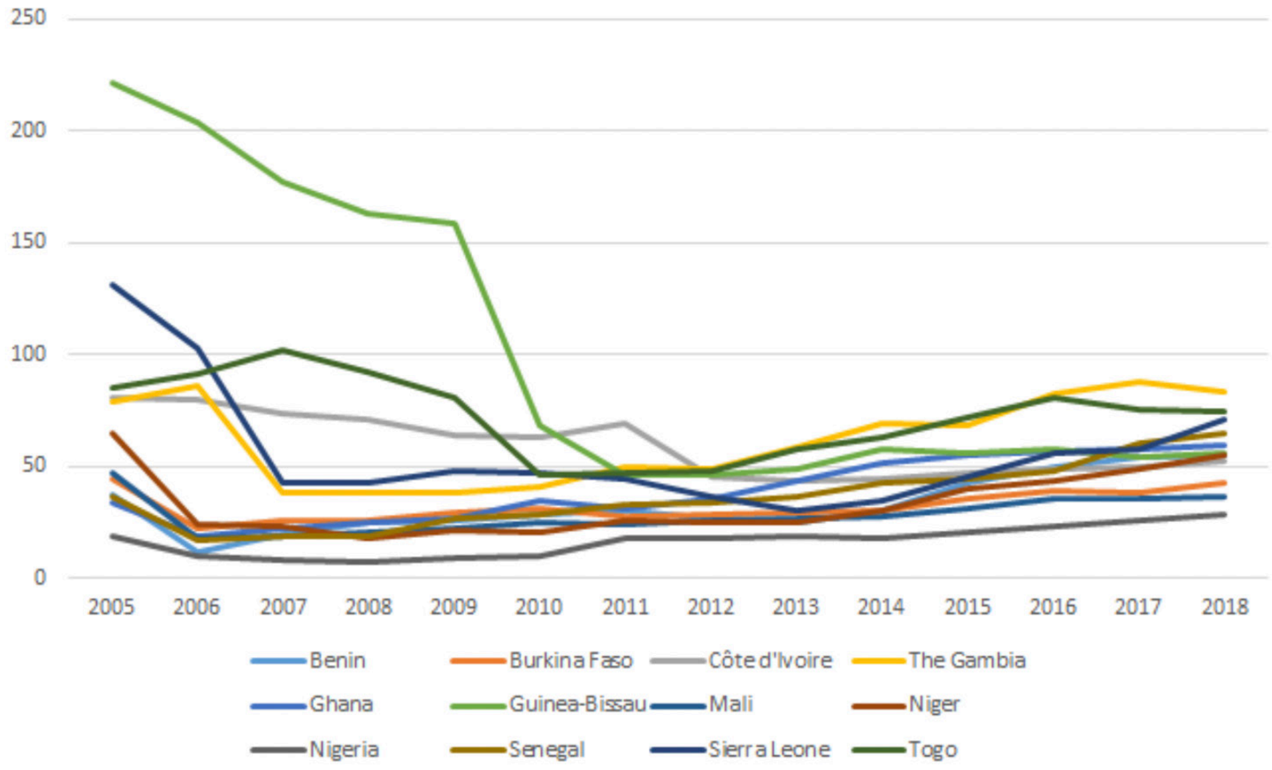

**Figure 5: Imports**

Evolution of intra-ECOWAS imports of Ivory Coast: Oil dependency



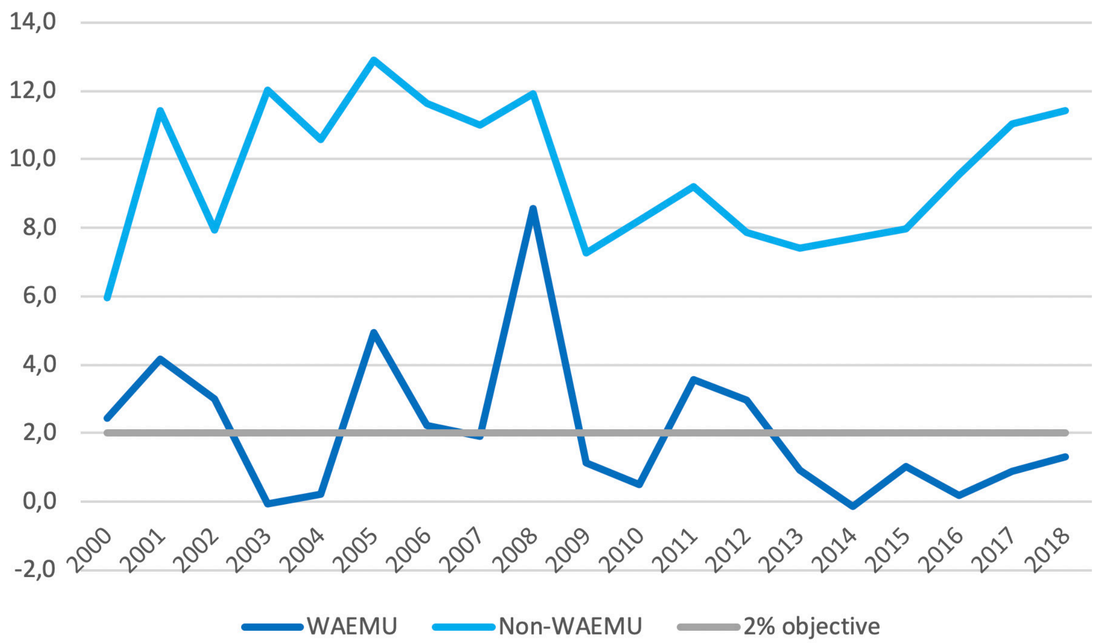
## Public Debt Levels

### Figure 6: General Governnment Gross Debt to GDP




## Inflation

### Figure 7: Inflation: 2000-2018



## 2. Theoretical Model

The theoretical model presented in this section is not novel and is borrowed from early work by Maurice Obstfeld (1985) and a business cycles adapted version by Clarida & Gali (1994). We present the building blocks.

$$(IS)\ \ y_t^d = d_t + \eta(s_t - p_t) - \sigma\big(i_t - E_t(p_{t+1} - p_t)\big)$$

$$(PS)\ \ p_t = (1-\theta)E_{t-1}p_t^e + \theta\, p_t^e$$

$$(LM)\ m_t^s - p_t = y_t - \lambda\, i_t$$

$$(UIP)\ i_t = E_t(s_{t+1} - s\_t)$$

Equation 8 is an open-economy IS equation where demand is driven positively by the real exchange rate (s-p) and a demand shock that follows the following process

$$d_t = d_{t-1} + \delta_t - \gamma\delta_{t-1}$$

where $\boldsymbol{\delta}$ is a demand shock.

Equation 9 is a price setting equation that states that prices are a weighted average of previously expected prices and current price expectation. Under perfect foresight only current expectations matters and the prices are fully determined by the supply side. Equation 10 is an LM equation that represents the set of equilibria on the money market. Equation 11 is the uncovered interest parity. Furthermore, we assume that money and output follow:

$$y_t^s = y_t^s + z_t$$

$$m_t = m_{t-1} + v_t$$

Where z and $\boldsymbol{v}$ are supply and demand shocks respectively

Solving this model yields the following equilibrium

$$\begin{cases} p_t = p_t^e - (1-\theta)(\nu_t - z_t + \dfrac{\lambda\gamma\delta_t}{(1+\lambda)(\eta+\sigma)}) \\ q_t = q_t^e - \dfrac{1+\lambda}{\lambda+\sigma+\eta}(\nu_t - z_t + \dfrac{\delta\gamma\delta_t}{(1+\lambda)(\eta+\sigma)} \\ y_t = y_t^s - (\eta+\sigma)\dfrac{1+\lambda}{\lambda+\sigma+\eta}(\nu_t - z_t + \dfrac{\lambda\gamma\delta_t}{(1+\lambda)(\eta+\sigma)} \end{cases}$$

This system of three equations fully defines our model and the dynamics.

## 3. Unit root tests

### Augmented Dickey-Fuller

In this test, the null hypothesis corresponds to the presence of a unit root. The test on logGDP and logGDPdef is based on a regression of the form

$$\Delta y_t = \alpha + \beta t + \varphi\, y_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta y_{t-i} + \varepsilon_t$$

The tested hypothesis is as follows

$$H_0 : \alpha = 0, \beta = 0, \varphi = 0$$

The test on logRER is based on the following regression

=

$$\Delta y_t = \alpha + \varphi\, y_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta y_{t-i} + \varepsilon_t$$

where the following hypothesis is tested

$$H_0 : \alpha = 0, \varphi = 0$$

### Kwiatowski, Phillips, Schmidt, Shin

In this test, the null corresponds to stationarity, that is the absence of a unit root test. Again, the property of the series is taken into account. A trend is introduced for the trending series (logGDP and logGDPdef).

In the first case we consider the following regression

$$y_t = \alpha + \varepsilon_t$$

while in the second we test;

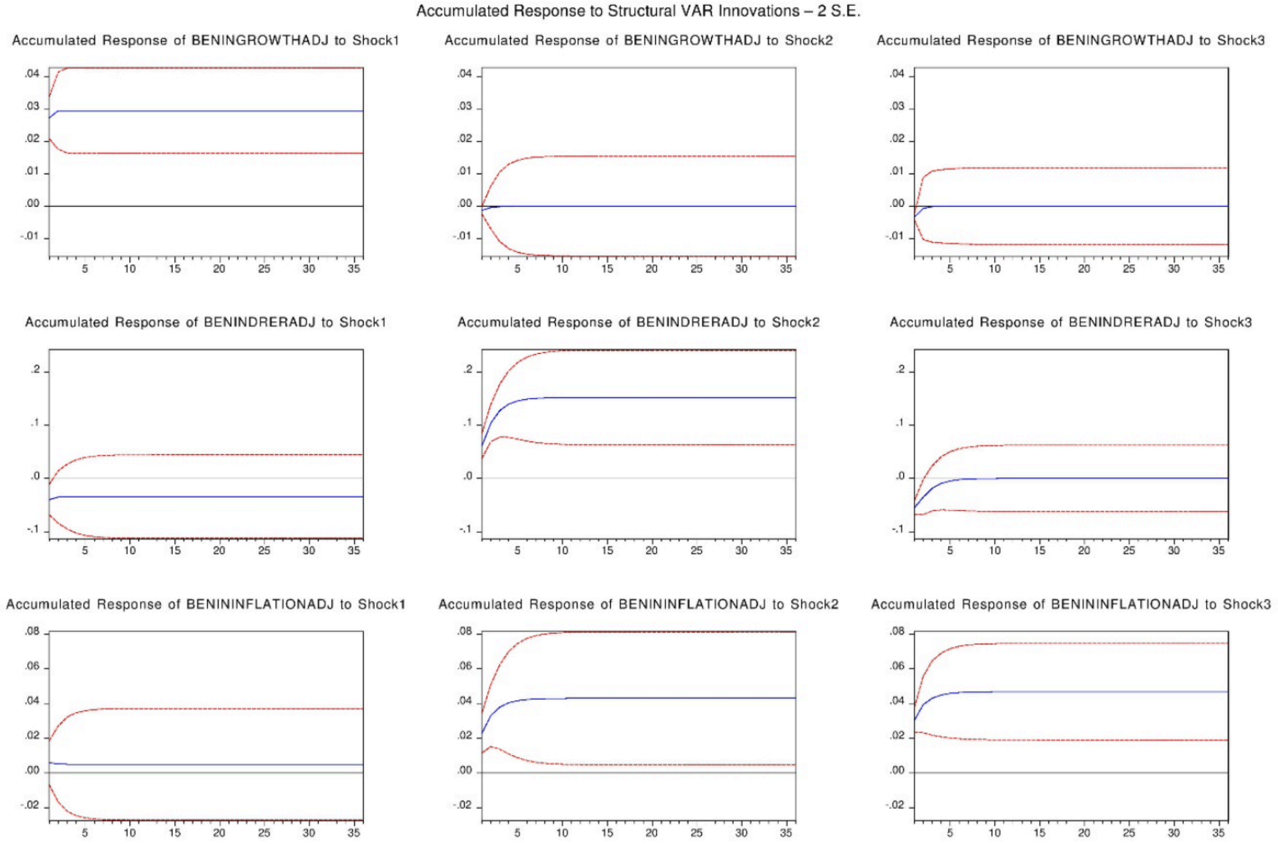
$$y_t = \alpha + \beta t + \varepsilon_t$$

In both cases the test is run on the extracted residuals of the regression, using the following hypothesis

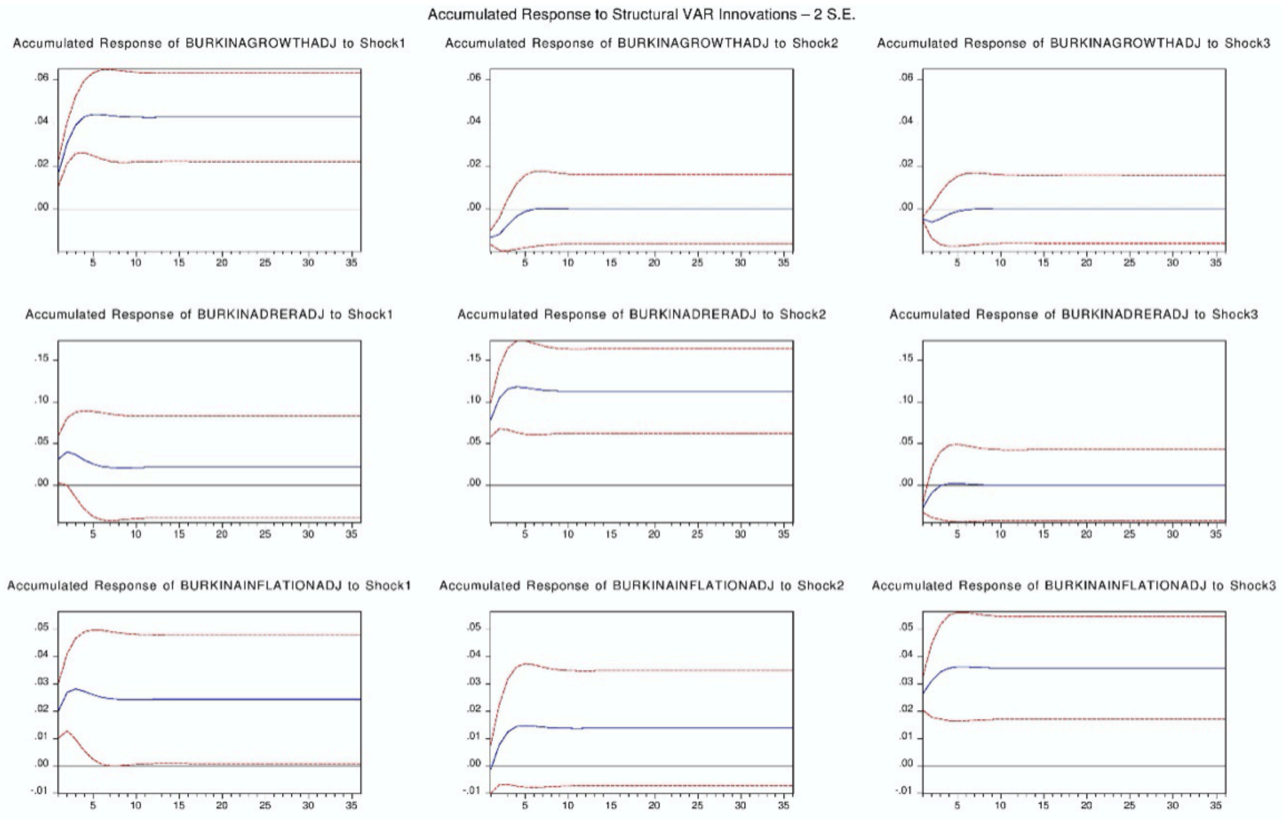
$$H_0 : \sigma_\varepsilon^2 = 0$$

## 4. Impulse responses

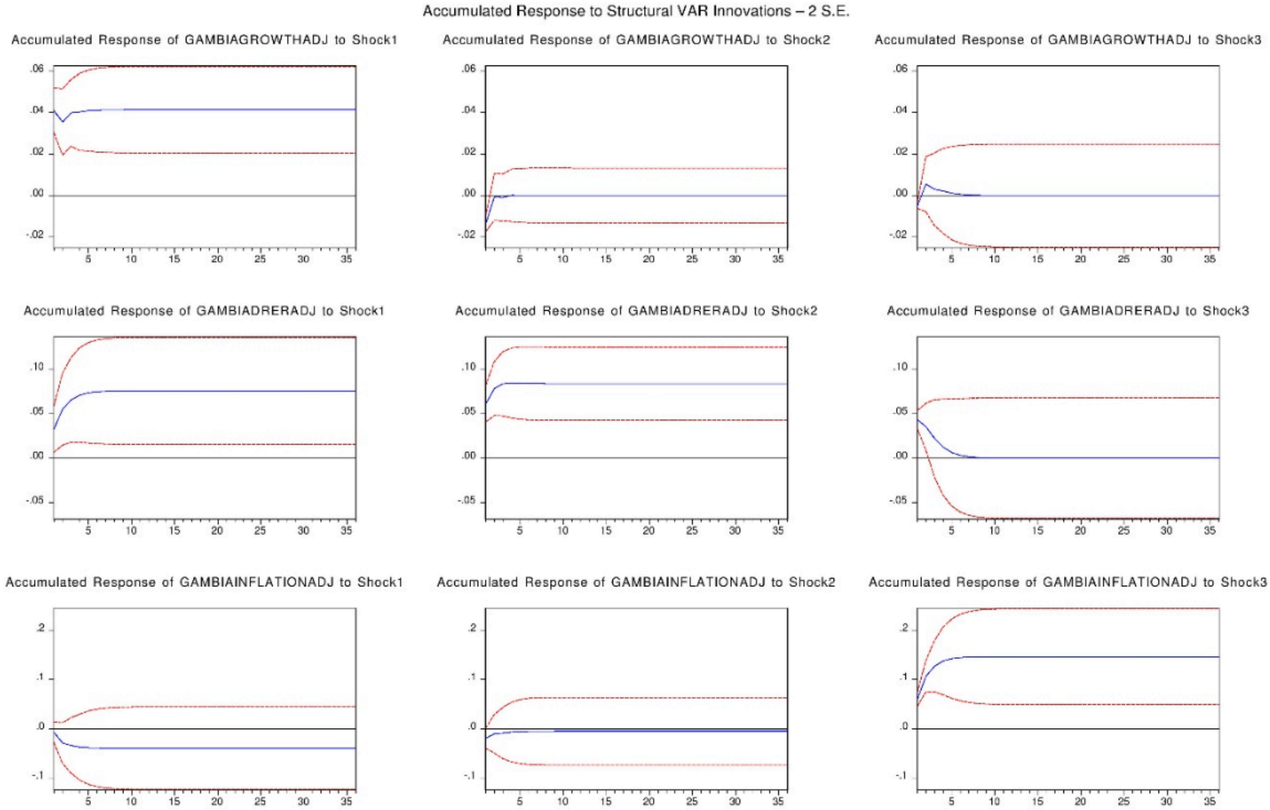
### Figure 8: Benin



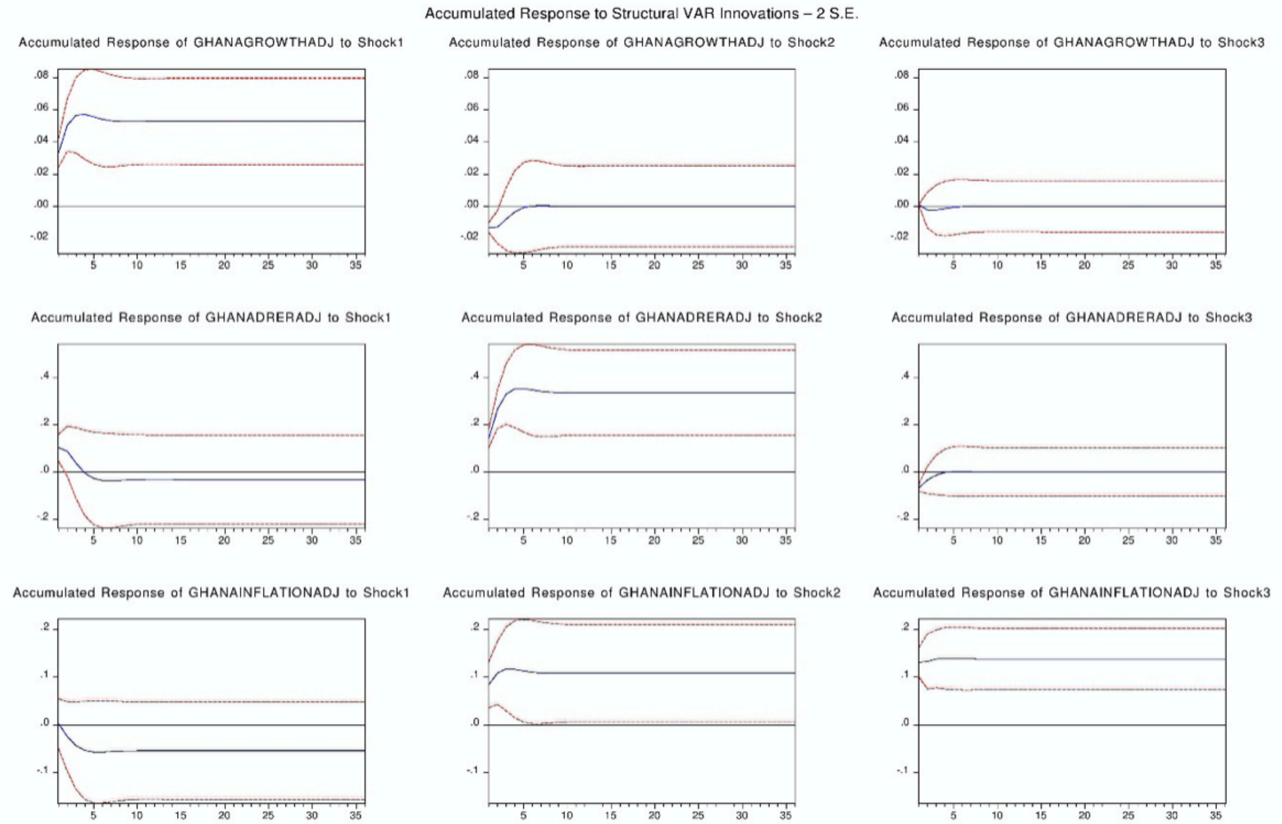

### Figure 9: Burkina Faso



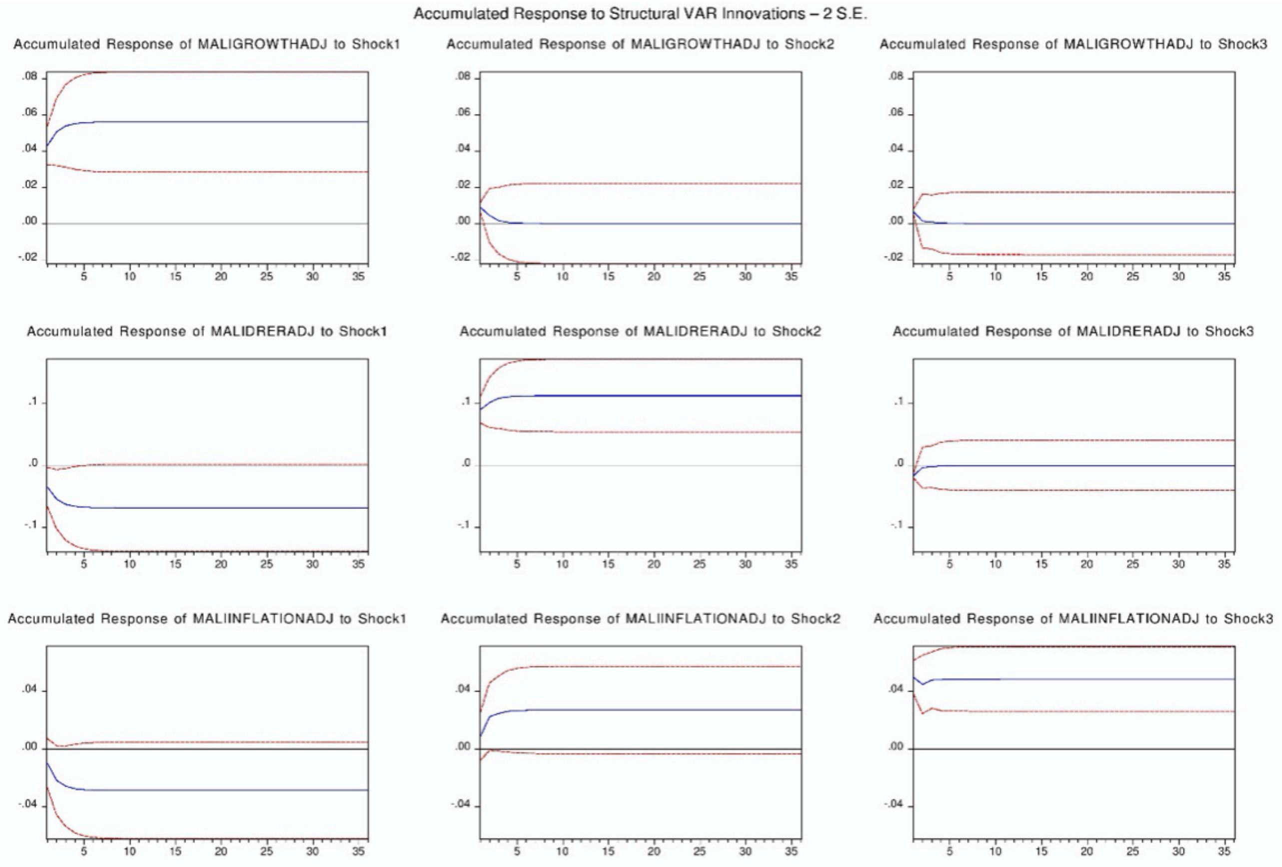
## Figure 10: The Gambia



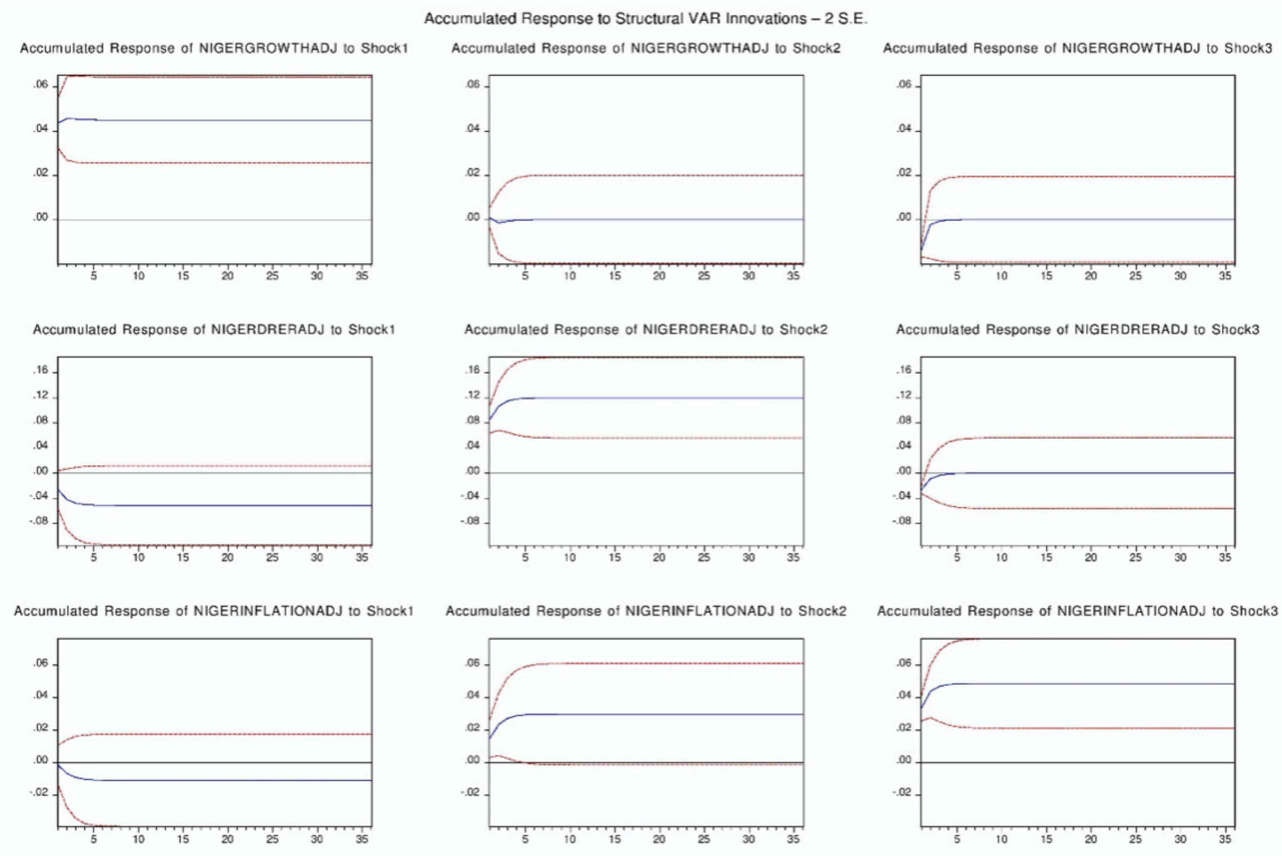

## Figure 11: Ghana



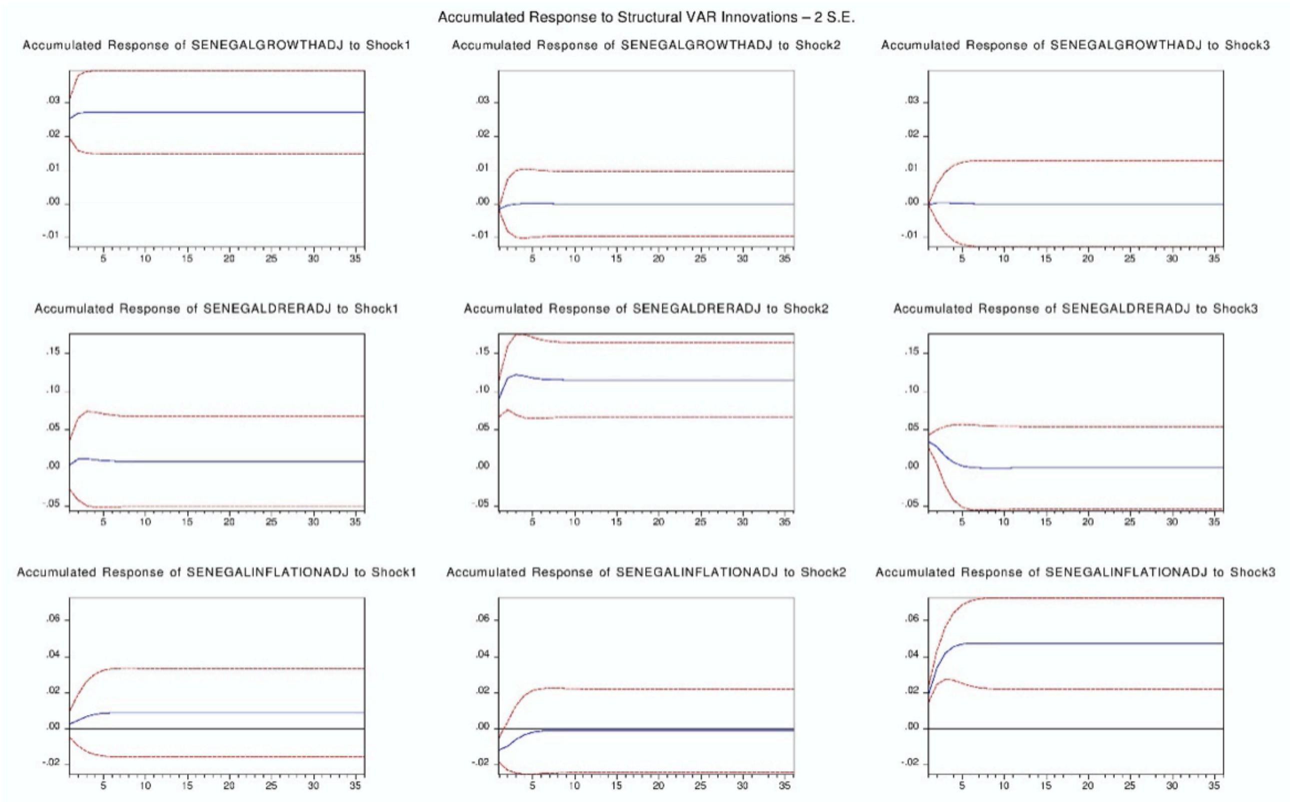
## Figure 12: Mali



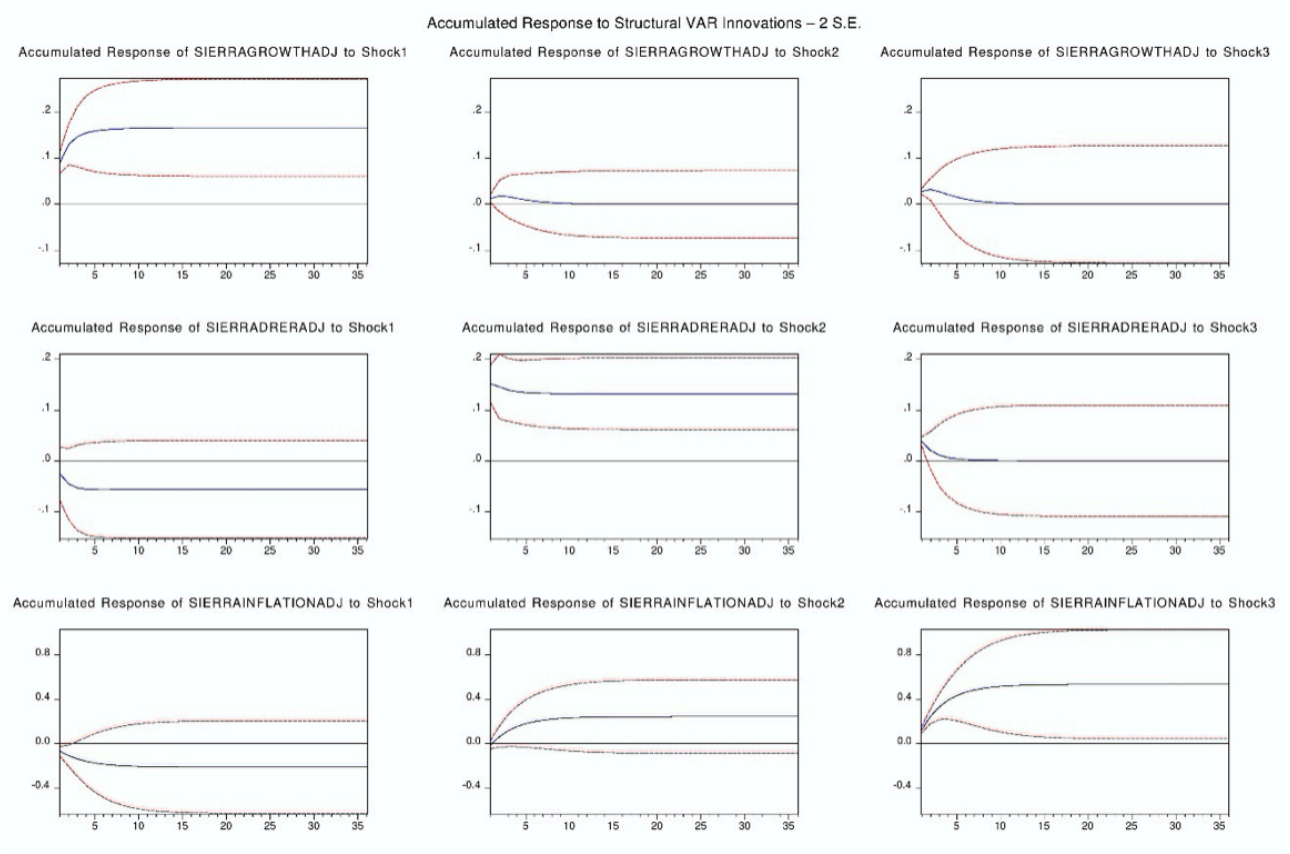

## Figure 13: Niger



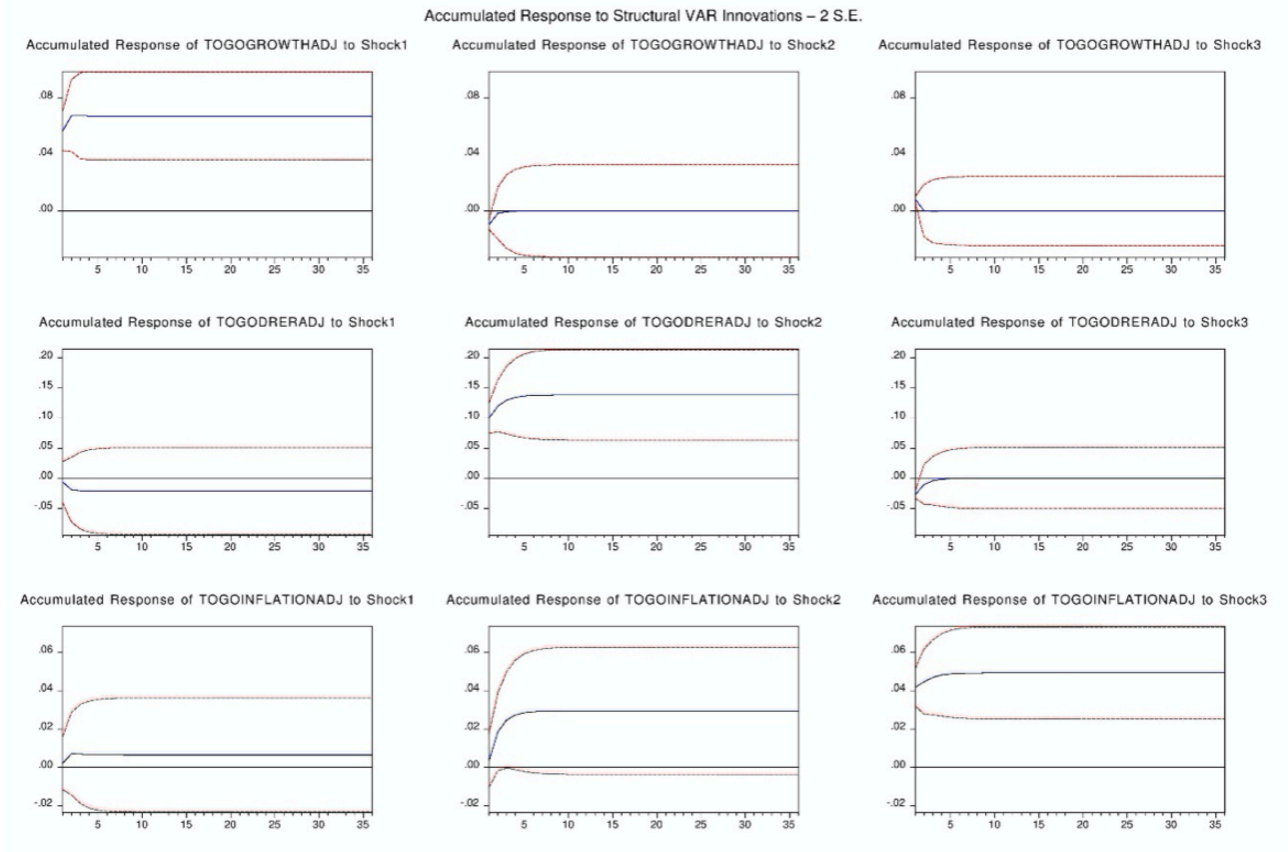
## Figure 14: Senegal




## Figure 15: Sierra Leone



## Figure 16: Togo



## Tables of variance decomposition

| Variance Decomposition of Benin's Growth: | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.027484 | 98.32870 | 0.210897 | 1.460406 |
| **2** | 0.027709 | 97.35063 | 0.302562 | 2.346811 |
| **3** | 0.027715 | 97.30635 | 0.310779 | 2.382869 |
| **4** | 0.027716 | 97.30449 | 0.311637 | 2.383874 |
| **5** | 0.027716 | 97.30423 | 0.311807 | 2.383964 |
| **6** | 0.027716 | 97.30417 | 0.311849 | 2.383985 |
| **7** | 0.027716 | 97.30415 | 0.311860 | 2.383990 |
| **8** | 0.027716 | 97.30415 | 0.311863 | 2.383992 |
| **9-36** | 0.027716 | 97.30414 | 0.311864 | 2.383992 |
| **Variance Decomposition of Benin's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.091497 | 18.92085 | 44.56507 | 36.51408 |
| **2** | 0.103167 | 15.08667 | 52.37300 | 32.54033 |
| **3** | 0.107169 | 13.99204 | 53.36775 | 32.64020 |
| **4** | 0.108223 | 13.72084 | 53.57815 | 32.70101 |
| **5** | 0.108492 | 13.65301 | 53.63132 | 32.71566 |
| **6** | 0.108560 | 13.63575 | 53.64501 | 32.71923 |
| **7** | 0.108578 | 13.63133 | 53.64853 | 32.72014 |
| **8** | 0.108583 | 13.63020 | 53.64943 | 32.72037 |
| **9** | 0.108584 | 13.62990 | 53.64966 | 32.72043 |
| **10** | 0.108584 | 13.62983 | 53.64972 | 32.72045 |
| **11-36** | 0.108584 | 13.62981 | 53.64974 | 32.72045 |
| **Variance Decomposition of Benin's Inflation:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.038432 | 2.330236 | 35.67991 | 61.98985 |
| **2** | 0.040769 | 2.095834 | 37.83956 | 60.06460 |
| **3** | 0.041226 | 2.051826 | 38.40192 | 59.54625 |
| **4** | 0.041339 | 2.040733 | 38.54460 | 59.41467 |
| **5** | 0.041367 | 2.037889 | 38.58096 | 59.38115 |
| **6** | 0.041375 | 2.037158 | 38.59027 | 59.37257 |
| **7** | 0.041377 | 2.036970 | 38.59266 | 59.37037 |
| **8** | 0.041377 | 2.036922 | 38.59327 | 59.36980 |
| **9** | 0.041377 | 2.036909 | 38.59343 | 59.36966 |
| **10** | 0.041377 | 2.036906 | 38.59347 | 59.36962 |
| **11** | 0.041377 | 2.036905 | 38.59348 | 59.36961 |
| **12-36** | 0.041377 | 2.036905 | 38.59349 | 59.36961 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Burkina Faso' Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.021850 | 60.01297 | 35.76635 | 4.220687 |
| **2** | 0.025945 | 70.97448 | 25.68837 | 3.337152 |
| **3** | 0.027667 | 71.58849 | 25.13743 | 3.274085 |
| **4** | 0.028261 | 70.43124 | 25.92721 | 3.641551 |
| **5** | 0.028415 | 69.81810 | 26.32258 | 3.859321 |
| **6** | 0.028446 | 69.66793 | 26.40747 | 3.924599 |
| **7** | 0.028453 | 69.65954 | 26.40664 | 3.933814 |
| **8** | 0.028456 | 69.66538 | 26.40129 | 3.933327 |
| **9** | 0.028458 | 69.66621 | 26.40062 | 3.933171 |
| **10** | 0.028458 | 69.66535 | 26.40121 | 3.933442 |
| **11** | 0.028458 | 69.66482 | 26.40155 | 3.933627 |
| **12** | 0.028458 | 69.66469 | 26.40163 | 3.933686 |
| **13** | 0.028458 | 69.66468 | 26.40163 | 3.933695 |
| **14-36** | 0.028458 | 69.66468 | 26.40162 | 3.933694 |
| **Variance Decomposition of Burkina Faso's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.088965 | 12.43435 | 78.53123 | 9.034418 |
| **2** | 0.094688 | 11.84115 | 76.74559 | 11.41326 |
| **3** | 0.095764 | 11.72559 | 76.35559 | 11.91882 |
| **4** | 0.096045 | 12.08298 | 75.97830 | 11.93872 |
| **5** | 0.096176 | 12.31148 | 75.78187 | 11.90665 |
| **6** | 0.096235 | 12.38181 | 75.72076 | 11.89742 |
| **7** | 0.096255 | 12.39216 | 75.70941 | 11.89843 |
| **8** | 0.096260 | 12.39178 | 75.70832 | 11.89990 |
| **9** | 0.096261 | 12.39162 | 75.70802 | 11.90035 |
| **10** | 0.096261 | 12.39191 | 75.70771 | 11.90038 |
| **11** | 0.096262 | 12.39210 | 75.70754 | 11.90035 |
| **12-36** | 0.096262 | 12.39217 | 75.70749 | 11.90034 |
| **Variance Decomposition of Burkina Faso's Inflation** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.033441 | 36.66894 | 0.136527 | 63.19453 |
| **2** | 0.035572 | 35.97028 | 6.467970 | 57.56175 |
| **3** | 0.036050 | 35.14031 | 8.057842 | 56.80185 |
| **4** | 0.036142 | 35.02242 | 8.295548 | 56.68204 |
| **5** | 0.036169 | 35.09071 | 8.293447 | 56.61585 |
| **6** | 0.036182 | 35.13226 | 8.291956 | 56.57578 |
| **7** | 0.036187 | 35.14155 | 8.298440 | 56.56001 |
| **8** | 0.036189 | 35.14134 | 8.302720 | 56.55594 |
| **9** | 0.036189 | 35.14064 | 8.304096 | 56.55526 |
| **10** | 0.036190 | 35.14052 | 8.304321 | 56.55515 |
| **11** | 0.036190 | 35.14058 | 8.304322 | 56.55510 |
| **12** | 0.036190 | 35.14061 | 8.304320 | 56.55507 |

| | | | | |
|---|---|---|---|---|
| **13** | 0.036190 | 35.14062 | 8.304325 | 56.55505 |
| **14** | 0.036190 | 35.14062 | 8.304329 | 56.55505 |
| **15-36** | 0.036190 | 35.14062 | 8.304330 | 56.55505 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Ivory Coast's Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.028205 | 98.77806 | 0.251631 | 0.970309 |
| **2** | 0.034528 | 99.11909 | 0.220799 | 0.660113 |
| **3** | 0.037042 | 99.18523 | 0.207807 | 0.606959 |
| **4** | 0.038100 | 99.20760 | 0.198489 | 0.593911 |
| **5** | 0.038555 | 99.21618 | 0.193955 | 0.589862 |
| **6** | 0.038753 | 99.21960 | 0.191978 | 0.588420 |
| **7** | 0.038840 | 99.22100 | 0.191136 | 0.587863 |
| **8** | 0.038877 | 99.22159 | 0.190777 | 0.587637 |
| **9** | 0.038894 | 99.22184 | 0.190622 | 0.587542 |
| **10** | 0.038901 | 99.22194 | 0.190555 | 0.587502 |
| **11** | 0.038904 | 99.22199 | 0.190526 | 0.587484 |
| **12-36** | 0.038906 | 99.22201 | 0.190513 | 0.587477 |
| **Variance Decomposition of Ivory Coast's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.105873 | 0.426432 | 99.22393 | 0.349640 |
| **2** | 0.110863 | 0.429599 | 99.19260 | 0.377802 |
| **3** | 0.111490 | 0.471401 | 99.12597 | 0.402627 |
| **4** | 0.111587 | 0.493357 | 99.09810 | 0.408540 |
| **5** | 0.111605 | 0.503043 | 99.08725 | 0.409707 |
| **6** | 0.111609 | 0.507207 | 99.08286 | 0.409934 |
| **7** | 0.111610 | 0.509000 | 99.08102 | 0.409981 |
| **8** | 0.111611 | 0.509776 | 99.08023 | 0.409991 |
| **9** | 0.111611 | 0.510113 | 99.07989 | 0.409993 |
| **10** | 0.111611 | 0.510260 | 99.07975 | 0.409994 |
| **11** | 0.111611 | 0.510324 | 99.07968 | 0.409994 |
| **12** | 0.111611 | 0.510352 | 99.07965 | 0.409994 |
| **13** | 0.111611 | 0.510364 | 99.07964 | 0.409994 |
| **14** | 0.111611 | 0.510370 | 99.07964 | 0.409994 |
| **15-36** | 0.111611 | 0.510372 | 99.07963 | 0.409994 |
| **Variance Decomposition Ivory Coast's Inflation:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.040502 | 2.564382 | 8.062095 | 89.37352 |
| **2** | 0.044229 | 3.683536 | 17.82695 | 78.48952 |
| **3** | 0.045183 | 4.889937 | 19.68826 | 75.42180 |
| **4** | 0.045448 | 5.528230 | 19.91358 | 74.55819 |
| **5** | 0.045537 | 5.825659 | 19.90699 | 74.26735 |

| | | | | |
|---|---|---|---|---|
| **6** | 0.045572 | 5.959007 | 19.88716 | 74.15383 |
| **7** | 0.045587 | 6.017993 | 19.87587 | 74.10614 |
| **8** | 0.045593 | 6.043950 | 19.87052 | 74.08553 |
| **9** | 0.045596 | 6.055345 | 19.86813 | 74.07653 |
| **10** | 0.045597 | 6.060343 | 19.86707 | 74.07259 |
| **11** | 0.045598 | 6.062533 | 19.86660 | 74.07087 |
| **12** | 0.045598 | 6.063493 | 19.86640 | 74.07011 |
| **13** | 0.045598 | 6.063913 | 19.86631 | 74.06978 |
| **14** | 0.045598 | 6.064097 | 19.86627 | 74.06963 |
| **15** | 0.045598 | 6.064178 | 19.86625 | 74.06957 |
| **16** | 0.045598 | 6.064213 | 19.86624 | 74.06954 |
| **17-36** | 0.045598 | 6.064228 | 19.86624 | 74.06953 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of The Gambia's Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.043506 | 88.81088 | 9.868019 | 1.321101 |
| **2** | 0.046925 | 77.70324 | 16.13823 | 6.158533 |
| **3** | 0.047193 | 77.68293 | 15.95762 | 6.359448 |
| **4** | 0.047212 | 77.62662 | 15.98849 | 6.384886 |
| **5** | 0.047229 | 77.59096 | 15.97710 | 6.431941 |
| **6** | 0.047233 | 77.58107 | 15.97471 | 6.444225 |
| **7** | 0.047234 | 77.57764 | 15.97392 | 6.448440 |
| **8** | 0.047234 | 77.57680 | 15.97375 | 6.449451 |
| **9** | 0.047234 | 77.57659 | 15.97371 | 6.449699 |
| **10-36** | 0.047234 | 77.57655 | 15.97370 | 6.449753 |
| **Variance Decomposition of The Gambia's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.081777 | 16.03564 | 55.70966 | 28.25470 |
| **2** | 0.086876 | 20.80720 | 53.28948 | 25.90332 |
| **3** | 0.088635 | 21.38981 | 51.56326 | 27.04693 |
| **4** | 0.089366 | 21.40753 | 50.73221 | 27.86026 |
| **5** | 0.089600 | 21.37365 | 50.46809 | 28.15826 |
| **6** | 0.089667 | 21.35867 | 50.39399 | 28.24734 |
| **7** | 0.089684 | 21.35396 | 50.37562 | 28.27042 |
| **8** | 0.089688 | 21.35272 | 50.37139 | 28.27589 |
| **9** | 0.089688 | 21.35242 | 50.37048 | 28.27710 |
| **10** | 0.089689 | 21.35236 | 50.37029 | 28.27735 |
| **11** | 0.089689 | 21.35234 | 50.37026 | 28.27740 |
| **12-36** | 0.089689 | 21.35234 | 50.37025 | 28.27741 |
| **Variance Decomposition of The Gambia's inflation** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.062936 | 1.311778 | 9.509805 | 89.17842 |

| | | | | |
|---|---|---|---|---|
| **2** | 0.082211 | 7.742260 | 6.838453 | 85.41929 |
| **3** | 0.084826 | 7.622853 | 6.450678 | 85.92647 |
| **4** | 0.085599 | 7.642421 | 6.393533 | 85.96405 |
| **5** | 0.085746 | 7.634020 | 6.381106 | 85.98487 |
| **6** | 0.085779 | 7.632353 | 6.379584 | 85.98806 |
| **7** | 0.085785 | 7.631826 | 6.379341 | 85.98883 |
| **8** | 0.085786 | 7.631714 | 6.379326 | 85.98896 |
| **9** | 0.085786 | 7.631690 | 6.379326 | 85.98898 |
| **10-36** | 0.085787 | 7.631686 | 6.379328 | 85.98899 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Ghana's Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.035847 | 86.65788 | 13.25848 | 0.083645 |
| **2** | 0.039847 | 88.50672 | 10.73207 | 0.761207 |
| **3** | 0.040626 | 87.44015 | 11.82725 | 0.732600 |
| **4** | 0.040886 | 86.34129 | 12.89291 | 0.765802 |
| **5** | 0.041006 | 85.96378 | 13.23907 | 0.797146 |
| **6** | 0.041050 | 85.91086 | 13.28111 | 0.808032 |
| **7** | 0.041062 | 85.91437 | 13.27591 | 0.809721 |
| **8** | 0.041064 | 85.91457 | 13.27572 | 0.809702 |
| **9** | 0.041065 | 85.91259 | 13.27769 | 0.809716 |
| **10** | 0.041065 | 85.91155 | 13.27867 | 0.809775 |
| **11-36** | 0.041065 | 85.91132 | 13.27887 | 0.809804 |
| **Variance Decomposition of Ghana's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.187636 | 30.25035 | 57.19334 | 12.55631 |
| **2** | 0.227965 | 20.94239 | 68.43733 | 10.62028 |
| **3** | 0.243075 | 22.68493 | 67.24122 | 10.07385 |
| **4** | 0.247872 | 24.62837 | 65.47840 | 9.893231 |
| **5** | 0.248990 | 25.27765 | 64.89305 | 9.829300 |
| **6** | 0.249217 | 25.35712 | 64.83140 | 9.811484 |
| **7** | 0.249289 | 25.34444 | 64.84808 | 9.807471 |
| **8** | 0.249322 | 25.34230 | 64.85124 | 9.806459 |
| **9** | 0.249334 | 25.34552 | 64.84840 | 9.806071 |
| **10** | 0.249338 | 25.34731 | 64.84678 | 9.805912 |
| **11** | 0.249339 | 25.34769 | 64.84645 | 9.805862 |
| **12** | 0.249339 | 25.34769 | 64.84646 | 9.805849 |
| **13** | 0.249339 | 25.34768 | 64.84647 | 9.805846 |
| **14** | 0.249339 | 25.34769 | 64.84647 | 9.805845 |
| **15** | 0.249339 | 25.34769 | 64.84647 | 9.805845 |
| **16-36** | 0.249339 | 25.34769 | 64.84646 | 9.805845 |

| **Variance Decomposition of Ghana's Inflation:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.155694 | 0.022385 | 28.95796 | 71.01966 |
| **2** | 0.159959 | 2.818259 | 29.88932 | 67.29242 |
| **3** | 0.161373 | 4.150446 | 29.62557 | 66.22398 |
| **4** | 0.161682 | 4.506380 | 29.51494 | 65.97868 |
| **5** | 0.161747 | 4.544704 | 29.52985 | 65.92545 |
| **6** | 0.161771 | 4.543387 | 29.54936 | 65.90726 |
| **7** | 0.161782 | 4.546266 | 29.55449 | 65.89924 |
| **8** | 0.161785 | 4.549177 | 29.55446 | 65.89636 |
| **9** | 0.161786 | 4.550265 | 29.55413 | 65.89560 |
| **10** | 0.161787 | 4.550456 | 29.55410 | 65.89544 |
| **11** | 0.161787 | 4.550462 | 29.55414 | 65.89540 |
| **12-36** | 0.161787 | 4.550463 | 29.55416 | 65.89538 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Mali's Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.044555 | 93.96726 | 3.905277 | 2.127467 |
| **2** | 0.045696 | 92.02120 | 4.650795 | 3.328004 |
| **3** | 0.045901 | 91.71103 | 4.979226 | 3.309748 |
| **4** | 0.045931 | 91.66922 | 5.012214 | 3.318569 |
| **5** | 0.045936 | 91.66205 | 5.019110 | 3.318838 |
| **6** | 0.045936 | 91.66093 | 5.020099 | 3.318969 |
| **7** | 0.045937 | 91.66075 | 5.020270 | 3.318983 |
| **8** | 0.045937 | 91.66072 | 5.020297 | 3.318986 |
| **9-36** | 0.045937 | 91.66071 | 5.020302 | 3.318986 |
| **Variance Decomposition of Mali's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.098190 | 12.64980 | 84.52312 | 2.827075 |
| **2** | 0.101580 | 15.48849 | 80.18173 | 4.329776 |
| **3** | 0.102185 | 15.98196 | 79.72323 | 4.294809 |
| **4** | 0.102273 | 16.05650 | 79.63888 | 4.304612 |
| **5** | 0.102287 | 16.06900 | 79.62631 | 4.304695 |
| **6** | 0.102290 | 16.07100 | 79.62418 | 4.304822 |
| **7** | 0.102290 | 16.07132 | 79.62385 | 4.304833 |
| **8** | 0.102290 | 16.07137 | 79.62379 | 4.304835 |
| **9-36** | 0.102290 | 16.07138 | 79.62378 | 4.304836 |
| **Variance Decomposition of Mali's Inflation:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.051591 | 3.612372 | 3.042026 | 93.34560 |
| **2** | 0.054874 | 7.888753 | 8.769616 | 83.34163 |
| **3** | 0.055151 | 8.343947 | 8.834434 | 82.82162 |

| | | | | |
|---|---|---|---|---|
| **4** | 0.055202 | 8.432209 | 8.896352 | 82.67144 |
| **5** | 0.055209 | 8.445404 | 8.901741 | 82.65285 |
| **6** | 0.055210 | 8.447641 | 8.902979 | 82.64938 |
| **7** | 0.055210 | 8.447997 | 8.903149 | 82.64885 |
| **8** | 0.055210 | 8.448055 | 8.903179 | 82.64877 |
| **9** | 0.055210 | 8.448065 | 8.903184 | 82.64875 |
| **10-36** | 0.055210 | 8.448066 | 8.903185 | 82.64875 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Niger's Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.045847 | 90.95592 | 0.029396 | 9.014685 |
| **2** | 0.047329 | 85.53044 | 0.274122 | 14.19544 |
| **3** | 0.047367 | 85.39710 | 0.301813 | 14.30108 |
| **4** | 0.047372 | 85.38071 | 0.310731 | 14.30856 |
| **5** | 0.047373 | 85.37845 | 0.312418 | 14.30913 |
| **6** | 0.047373 | 85.37813 | 0.312683 | 14.30919 |
| **7** | 0.047373 | 85.37808 | 0.312722 | 14.30920 |
| **8-36** | 0.047373 | 85.37808 | 0.312728 | 14.30920 |
| **Variance Decomposition of Niger's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.093190 | 7.778893 | 84.28206 | 7.939052 |
| **2** | 0.098399 | 9.578080 | 80.13919 | 10.28273 |
| **3** | 0.099076 | 9.783866 | 79.77686 | 10.43927 |
| **4** | 0.099173 | 9.813300 | 79.72325 | 10.46345 |
| **5** | 0.099187 | 9.817500 | 79.71563 | 10.46687 |
| **6** | 0.099189 | 9.818102 | 79.71454 | 10.46736 |
| **7** | 0.099189 | 9.818188 | 79.71439 | 10.46743 |
| **8-36** | 0.099189 | 9.818200 | 79.71436 | 10.46744 |
| **Variance Decomposition of Niger's Inflation** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.036776 | 0.172262 | 16.42733 | 83.40040 |
| **2** | 0.039506 | 1.876069 | 18.98646 | 79.13747 |
| **3** | 0.039900 | 2.240784 | 19.55116 | 78.20805 |
| **4** | 0.039958 | 2.302152 | 19.64250 | 78.05535 |
| **5** | 0.039967 | 2.311489 | 19.65624 | 78.03228 |
| **6** | 0.039968 | 2.312857 | 19.65824 | 78.02890 |
| **7** | 0.039968 | 2.313055 | 19.65853 | 78.02842 |
| **8-36** | 0.039968 | 2.313083 | 19.65857 | 78.02835 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Nigeria's Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.042085 | 98.75134 | 0.735674 | 0.512986 |
| **2** | 0.045854 | 98.85903 | 0.669604 | 0.471365 |
| **3** | 0.046514 | 98.77925 | 0.717538 | 0.503210 |
| **4** | 0.046629 | 98.74519 | 0.738182 | 0.516633 |
| **5** | 0.046649 | 98.73618 | 0.743657 | 0.520162 |
| **6** | 0.046652 | 98.73423 | 0.744844 | 0.520924 |
| **7** | 0.046653 | 98.73386 | 0.745074 | 0.521071 |
| **8** | 0.046653 | 98.73379 | 0.745115 | 0.521098 |
| **9-36** | 0.046653 | 98.73378 | 0.745122 | 0.521102 |
| **Variance Decomposition of Nigeria's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.200003 | 1.491488 | 94.79976 | 3.708757 |
| **2** | 0.205739 | 1.965510 | 92.50023 | 5.534261 |
| **3** | 0.206315 | 2.177169 | 92.19253 | 5.630299 |
| **4** | 0.206395 | 2.234811 | 92.13247 | 5.632717 |
| **5** | 0.206409 | 2.247446 | 92.12041 | 5.632144 |
| **6** | 0.206412 | 2.249906 | 92.11809 | 5.632003 |
| **7** | 0.206412 | 2.250352 | 92.11767 | 5.631981 |
| **8** | 0.206412 | 2.250428 | 92.11759 | 5.631979 |
| **9** | 0.206412 | 2.250441 | 92.11758 | 5.631978 |
| **10-36** | 0.206412 | 2.250443 | 92.11758 | 5.631978 |
| **Variance Decomposition of Nigeria's Inflation:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.123712 | 0.556539 | 19.84941 | 79.59405 |
| **2** | 0.127246 | 0.539736 | 22.21829 | 77.24197 |
| **3** | 0.127545 | 0.552692 | 22.39361 | 77.05370 |
| **4** | 0.127573 | 0.562874 | 22.40455 | 77.03257 |
| **5** | 0.127576 | 0.566086 | 22.40465 | 77.02926 |
| **6** | 0.127577 | 0.566844 | 22.40452 | 77.02864 |
| **7** | 0.127577 | 0.566999 | 22.40448 | 77.02852 |
| **8** | 0.127577 | 0.567027 | 22.40447 | 77.02850 |
| **9** | 0.127577 | 0.567032 | 22.40447 | 77.02849 |
| **10-36** | 0.127577 | 0.567033 | 22.40447 | 77.02849 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Senegal's growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.025317 | 99.61614 | 0.372608 | 0.011254 |
| **2** | 0.025395 | 99.39219 | 0.548246 | 0.059563 |
| **3** | 0.025400 | 99.36368 | 0.576712 | 0.059611 |
| **4** | 0.025400 | 99.35999 | 0.578353 | 0.061662 |

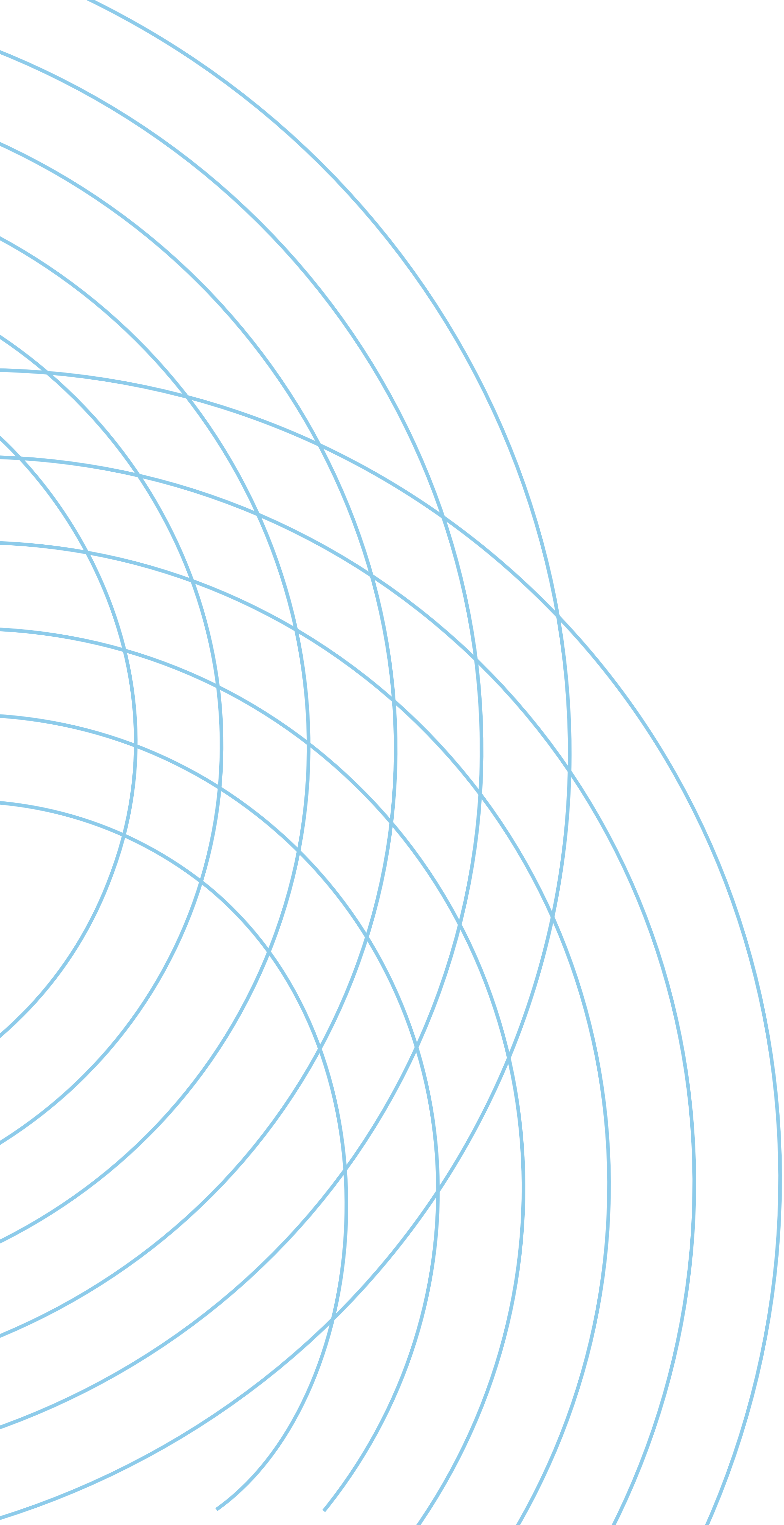
| | | | | |
|---|---|---|---|---|
| **5** | 0.025401 | 99.35849 | 0.578345 | 0.063164 |
| **6** | 0.025401 | 99.35791 | 0.578420 | 0.063669 |
| **7** | 0.025401 | 99.35775 | 0.578468 | 0.063781 |
| **8** | 0.025401 | 99.35772 | 0.578483 | 0.063799 |
| **9-36** | 0.025401 | 99.35771 | 0.578486 | 0.063800 |
| **Variance Decomposition of Senegal's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.097991 | 0.186217 | 87.28858 | 12.52520 |
| **2** | 0.102000 | 0.698616 | 87.24702 | 12.05437 |
| **3** | 0.102800 | 0.689650 | 86.06180 | 13.24855 |
| **4** | 0.103162 | 0.701072 | 85.48770 | 13.81123 |
| **5** | 0.103287 | 0.712080 | 85.32967 | 13.95825 |
| **6** | 0.103317 | 0.716046 | 85.29991 | 13.98405 |
| **7** | 0.103323 | 0.716959 | 85.29616 | 13.98688 |
| **8-36** | 0.103324 | 0.717103 | 85.29593 | 13.98697 |
| **Variance Decomposition of Senegal's Inflation:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.022564 | 1.371521 | 26.78835 | 71.84013 |
| **2** | 0.027125 | 1.574486 | 19.06080 | 79.36472 |
| **3** | 0.028627 | 1.906472 | 18.82846 | 79.26507 |
| **4** | 0.029006 | 2.040189 | 19.17137 | 78.78844 |
| **5** | 0.029078 | 2.074289 | 19.30961 | 78.61610 |
| **6** | 0.029088 | 2.080270 | 19.34107 | 78.57866 |
| **7** | 0.029089 | 2.080930 | 19.34558 | 78.57348 |
| **8** | 0.029089 | 2.080952 | 19.34586 | 78.57319 |
| **9-36** | 0.029089 | 2.080948 | 19.34582 | 78.57323 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Sierra Leone's Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.096017 | 89.81184 | 1.773635 | 8.414530 |
| **2** | 0.103741 | 90.85638 | 1.767808 | 7.375812 |
| **3** | 0.105245 | 90.89238 | 1.744215 | 7.363408 |
| **4** | 0.105797 | 90.53014 | 1.831154 | 7.638706 |
| **5** | 0.106077 | 90.21107 | 1.916263 | 7.872665 |
| **6** | 0.106226 | 90.01039 | 1.971839 | 8.017773 |
| **7** | 0.106304 | 89.89874 | 2.003287 | 8.097972 |
| **8** | 0.106344 | 89.83998 | 2.019977 | 8.140043 |
| **9** | 0.106364 | 89.80989 | 2.028562 | 8.161553 |
| **10** | 0.106374 | 89.79469 | 2.032907 | 8.172405 |
| **11** | 0.106379 | 89.78707 | 2.035087 | 8.177842 |
| **12** | 0.106381 | 89.78327 | 2.036177 | 8.180557 |
| **13** | 0.106383 | 89.78137 | 2.036720 | 8.181909 |

| | | | | |
|---|---|---|---|---|
| **14** | 0.106383 | 89.78043 | 2.036990 | 8.182583 |
| **15-36** | 0.106384 | 89.77996 | 2.037125 | 8.182917 |
| **Variance Decomposition of Sierra Leone's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.158665 | 2.643623 | 91.64619 | 5.710183 |
| **2** | 0.160963 | 4.097587 | 89.19536 | 6.707050 |
| **3** | 0.161541 | 4.286624 | 88.71333 | 7.000048 |
| **4** | 0.161658 | 4.304621 | 88.62408 | 7.071300 |
| **5** | 0.161686 | 4.304976 | 88.60357 | 7.091454 |
| **6** | 0.161694 | 4.304540 | 88.59725 | 7.098212 |
| **7** | 0.161698 | 4.304397 | 88.59478 | 7.100821 |
| **8** | 0.161699 | 4.304380 | 88.59368 | 7.101935 |
| **9** | 0.161700 | 4.304390 | 88.59317 | 7.102443 |
| **10** | 0.161700 | 4.304401 | 88.59292 | 7.102684 |
| **11** | 0.161700 | 4.304408 | 88.59279 | 7.102800 |
| **12-36** | 0.161700 | 4.304412 | 88.59273 | 7.102857 |
| **Variance Decomposition of Sierra Leone's Inflation:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.142121 | 24.62154 | 0.317111 | 75.06135 |
| **2** | 0.203890 | 15.87035 | 12.32612 | 71.80353 |
| **3** | 0.229523 | 14.16406 | 15.10649 | 70.72945 |
| **4** | 0.241184 | 13.60957 | 16.08252 | 70.30791 |
| **5** | 0.246746 | 13.38622 | 16.49521 | 70.11858 |
| **6** | 0.249457 | 13.28645 | 16.68500 | 70.02855 |
| **7** | 0.250792 | 13.23950 | 16.77581 | 69.98469 |
| **8** | 0.251452 | 13.21681 | 16.82011 | 69.96309 |
| **9** | 0.251779 | 13.20569 | 16.84192 | 69.95239 |
| **10** | 0.251942 | 13.20021 | 16.85271 | 69.94709 |
| **11** | 0.252023 | 13.19749 | 16.85806 | 69.94445 |
| **12** | 0.252063 | 13.19614 | 16.86071 | 69.94314 |
| **13** | 0.252083 | 13.19547 | 16.86204 | 69.94249 |
| **14-36** | 0.252093 | 13.19514 | 16.86269 | 69.94217 |
| **Factorization: Structural** | | | | |

| **Variance Decomposition of Togo's Growth:** | | | | |
|---|---|---|---|---|
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.058238 | 95.27075 | 2.683123 | 2.046129 |
| **2** | 0.060275 | 92.00947 | 4.227686 | 3.762842 |
| **3** | 0.060289 | 91.96824 | 4.265563 | 3.766199 |
| **4** | 0.060290 | 91.96615 | 4.266819 | 3.767028 |
| **5** | 0.060290 | 91.96574 | 4.267112 | 3.767146 |
| **6** | 0.060290 | 91.96566 | 4.267183 | 3.767161 |
| **7** | 0.060290 | 91.96564 | 4.267197 | 3.767164 |

| | | | | |
|---|---|---|---|---|
| **8** | 0.060290 | 91.96563 | 4.267200 | 3.767165 |
| **9-36** | 0.060290 | 91.96563 | 4.267201 | 3.767165 |
| **Variance Decomposition of Togo's RER:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.103697 | 0.403576 | 92.66384 | 6.932585 |
| **2** | 0.107724 | 1.752713 | 89.38740 | 8.859889 |
| **3** | 0.108361 | 1.757541 | 89.15481 | 9.087650 |
| **4** | 0.108490 | 1.754534 | 89.13247 | 9.112995 |
| **5** | 0.108517 | 1.753983 | 89.12825 | 9.117767 |
| **6** | 0.108522 | 1.753882 | 89.12736 | 9.118762 |
| **7** | 0.108523 | 1.753862 | 89.12717 | 9.118964 |
| **8** | 0.108523 | 1.753858 | 89.12714 | 9.119005 |
| **9-36** | 0.108523 | 1.753857 | 89.12713 | 9.119013 |
| **Variance Decomposition of Togo's Inflation:** | | | | |
| **Period** | S.E. | Supply | Demand | Nominal |
| **1** | 0.041827 | 0.286824 | 0.731941 | 98.98124 |
| **2** | 0.044797 | 1.425519 | 11.82724 | 86.74724 |
| **3** | 0.045280 | 1.396720 | 13.44636 | 85.15692 |
| **4** | 0.045371 | 1.395172 | 13.71471 | 84.89012 |
| **5** | 0.045390 | 1.394710 | 13.76770 | 84.83759 |
| **6** | 0.045394 | 1.394600 | 13.77845 | 84.82695 |
| **7** | 0.045394 | 1.394578 | 13.78062 | 84.82481 |
| **8** | 0.045394 | 1.394573 | 13.78105 | 84.82437 |
| **9** | 0.045394 | 1.394572 | 13.78114 | 84.82429 |
| **10-36** | 0.045394 | 1.394572 | 13.78116 | 84.82427 |
| **Factorization: Structural** | | | | |



**Policy Center for the New South**

Suncity Complex, Building C, Av. Addolb,
Albortokal Street, Hay Riad, Rabat,
Morocco.

Email : contact@policycenter.ma
Phone : +212 5 37 54 04 04
Fax : +212 5 37 71 31 54
Website : www.policycenter.ma