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Original Paper

Asymmetric Shocks Patterns in the Central African Economic and Monetary Community

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Abstract

Assessing the economic efficiency of countries' participation to a currency union has become a relevant topic since the introduction of the Optimum Currency Area (OCA) theory by Mundell (1961). This paper attempts to evaluate the performance of the Central African Economic and Monetary Community (CAEMC) as a currency union in the context of exposure to asymmetric shocks. We first identify structural macroeconomic shocks within the region using the Blanchard and Quah Method. We find that aggregate demand shocks fluctuations display more symmetric patterns than those of aggregate supply shocks. Chad is the apparent outlier, as it is the only economy in the monetary union to experience negative supply shocks. This suggests that the loss of monetary sovereignty might result in significant adjustment costs.

Keywords

asymmetric shocks, currency area, aggregate demand, aggregate supply

1. Introduction

Recently, discussion about the CFA Franc and the role it plays in the dependence of francophone African countries to their former colonial power France, are raising some controversies as well as public concern about the risk of currency devaluation. In response to that, several summits were held in 2016, 2018 and 2019, respectively in Yaoundé, N'djamena and Yaoundé where the Heads of member states along with the Chairperson of the International Monetary Fund (IMF) were in attendance to discuss the possible devaluation of the local currency. The Heads of member states in attendance chose to comply with fiscal adjustment, thus avoiding monetary adjustment and a possible devaluation. They were able to do so as they received financial support from France, The European Union (EU), the IMF and the World Bank in accordance to the existing agreements with France that implies the guarantee of the CFA franc's convertibility to the French franc (FF) and since 2000, to the euro in exchange for the deposit at least fifty percent of the member states' external reserves into special accounts held by the French treasury. Besides, a previous devaluation of the CFA franc against the French currency did take place in 1994, and further currency depreciation occurred in 2000 during the introduction of France's new currency and the disappearance of the French franc. Central African Economic and Monetary Community (CAEMC) economies have been confronted to a structural balance of payments deficit, thus putting a downward pressure on the peg. Capital controls as well as fiscal consolidation are implemented in the region in order to limit capital outflows and deficits. However, this contradicts Mundell (1973) who presented capital movements and transfer payments as a solution to cushion an economic shock and a means of recovery for depressed countries.

The sole purpose of having an entire geographical area sharing a common currency is to maximize economic efficiency as stated by the Optimum Currency Area (OCA) theory. Yet, after more than half a century of existence, it is not clear whether or not the CFA franc is favorable to the economies of CAEMC countries. The theory holds that an entire area should adopt a fixed exchange rate administration between currencies or a single currency within its geographic boundaries in order to benefit from the reduction of exchange rate uncertainty. Nevertheless, in order for the currency union to be considered optimal, the economic gain obtained by the ensuing increase of intraregional trade must outweigh the cost of losing control over monetary sovereignty. For this reason, a country that considers membership in a currency union has to balance the economic stability loss against the monetary efficiency of a single currency. Moreover, Baldwin and Wyplosz (2004) stress that the loss of economic monetary policy sovereignty becomes most significant for members of a currency union if poorly integrated member countries face asymmetric macroeconomic shocks.

On the other hand, a macroeconomic shock is considered to be asymmetric if only one part of the currency union is hit by the shock or in the case where the entire union is affected, some member countries differ widely in term of the shock's impact on their economies. A positive (negative) demand shock for instance will certainly result in disequilibrium in output and prices as they become too high (low) in those countries. Hence, in the case where member countries are hit by idiosyncratic shocks or have their economies being affected differently by a common shock, monetary policies decided by the common central bank to correct the disequilibrium might end up helping some countries overcome the shock at the expense of others. Therefore, assessing economic efficiency of the CFA Franc zone, particularly the CAEMC, in the context of exposure to major macroeconomic shocks by identifying structural shocks first, and then evaluating the degree of asymmetry among the member states is our main purpose in this study.

2. The CFA Franc Zone and Asymmetric Shocks in the Literature

An OCA is a geographical region where countries maximize economic efficiency by sharing a common currency. Mundell (1961) along with Mckinnon (1963) and Kenen (1969) establish criteria designed to assess countries' suitability to benefit from a membership to a currency area. The said criteria fall into two different groups. The first group consists in the criteria for reducing the area's exposure to asymmetric shocks, including similarity of business cycles, production diversification and economic integration among the countries of the region. Within the second group, we find criteria that aim to facilitate adjustment to asymmetric shocks such as labor mobility, transfer payments and homogeneity of preference.

Several methods have been used in academic research in order to measure shock asymmetry. Frankel and Rose (1998), as well as Kouparitas (2001), chose the business cycle approach establishing that the higher the synchronization across member states, the lower the adjustment cost. Indeed, a currency union's exposure to asymmetric shocks tends to be reduced if member countries have similar economic structure, preventing the common monetary policy from causing damage. In order to evaluate the degree of economic heterogeneity, Stockman (1988) isolates country specific and industry-specific shocks. An approach followed by Zhao and Kim (2009) while comparing the European Monetary Union (EMU) to the CFA franc zone. Using a structural vector auto regression (SVAR) method, they find that compared to the EMU where countries are influenced by regional shocks, the CFA franc zone countries are strongly influenced by country-specific shocks. Therefore, they conclude that high degree of economic heterogeneity across the CFA franc zone will subject member states to asymmetric shocks. These findings confirm a previous comparison between the EMU and the CFA franc zone done by Strauss-kahn (2003), who describe member countries' economic structure as displaying a as the lack of similarity. Along the lines of Bayoumi and Eichengreen (1993) idea of focusing on demand versus supply shocks, Houssa (2008) resorts to dynamic factor model to analyze the fluctuations of aggregate demand and aggregate supply shocks. He concludes that although West African countries member of the CFA zone tend to have a similar response to demand shocks, supply shocks appear to display more asymmetry, making the adjustment more costly. A more optimistic conclusion was made by Coulibaly and Gnimassoun (2013) after they analyzed convergence and exchange rate misalignments within the West African Economic and Monetary Union (WAEMU). They declare WAEMU to be the most homogeneous area out of the two CFA franc zones (Note 1).

All the same designed to reduce exposure to shocks, the openness criterion originally introduced by Mckinnon (1963) and further described by Baldwin and Wyploz (2004) suggests that the more member countries are open to international trade, the more it will prevent them from losing policy independence, even in the case of a fixed exchange rate regime. As a matter of fact, the nominal exchange rate can no longer be considered an important adjustment tool because changes in its nominal value are quickly followed by changes in domestic prices, leaving the real exchange rate unaffected for very open countries. Furthermore, the main benefit of sharing a common currency and thus suppressing exchange rate uncertainty and transaction costs between countries comes only if intraregional trade is substantial and economic integration high. Finally, the Kenen (1969) criterion implies that the impact of sector specific shocks is reduced if countries produce a wide range of products and therefore have a low degree of specialization. In the same vein, Kalemli-Ozcan, Sorensen and Yosha (2001) compare a cross-section of European countries to a cross-section of US states and find that greater industrial specialization leads to lower synchronization of GDP fluctuations, thus creating more asymmetry. Unlike the EMU, studies on the CFA franc zone monetary integration are scarce, the reason being the lack of availability of economic data in the least developed CFA franc zone countries. In this context, assessing the degree of openness in trade for the region becomes challenging as much of the cross-border trade between countries goes unreported. In his attempt to apply the OCA theory to the franc zone, Strauss-Kahn (2003) notes the lack of production diversification of member countries, as most of those are specialized in exporting raw commodities. The same goes for economic integration, as intra-regional trade accounts for 6 percent of total trade in CAEMC and 12 percent in WAEMU. Besides he confirms Gurtner's (1999) observation that heterogeneity of production remains very high, the export base very narrow and intraregional trade remains very low.

Empirical testing using various techniques thus far has shown that the Central and West African monetary unions do not fit criteria designed to reduce exposure to asymmetric shocks, which could threaten the sustainability of the CFA franc zone. The common monetary policy may differ sharply from the optimal policy one country should implement in case of idiosyncratic shocks and the only country-specific response available is through fiscal policy. Even in this case, Chambas (1994) finds francophone Africa fiscal instruments too unwieldy to be considered as reliable stabilization tools. Thereby, testing that the zones have developed a functioning adjustment mechanism to absorb imbalances and smooth adverse macroeconomic shocks can help one determine whether or not the CFA zone is at the very least sustainable. In this regard, Gurtner (1999) finds it difficult to evaluate the degree of labor mobility of both zones, and conclude that neither WAEMU nor CAEMC fit the classical criteria of OCA designed for adjustment facilitation, as defined in the literature. Devarajan and Boccara (1993) came to the same conclusion, and show that factor mobility is low within the CFA franc zone. Some searchers share this view that even if the CFA franc zone cannot technically be considered as an OCA, the monetary unions that constitute the zone are still sustainable for various reasons. One of them, Boughton (1993), sees France's role as the reason why member states benefit from their participation to currency unions. Others like M'Bet and Niamkey (1994) provide arguments implying that the CFA franc zones in their current structure is long way from optimality and many member countries are worse off participating in this currency union. On the contrary, resorting to the Behavioral Equilibrium Exchange Rate (BEER) approach, Couharde et al. (2013) test the sustainability hypothesis and conclude that internal and external balances have been fostered and adjustments facilitated as a whole compared to other sub-Saharan countries, along the lines of Mundell (1973) risk sharing theory.

3. Methodology and Estimation Techniques

Blanchard and Quah (1989) permanent and transitory shocks decomposition of output inspired many existing papers on the identification of structural shocks. Bayoumi and Eichengreen (1992), use this approach of VAR decomposition when analyzing data on output and prices for eleven European countries to identify aggregate supply and demand disturbances. In order to identify all relevant sources of output fluctuations, they impose a set of restrictions on the dynamic responses of variables in the long-run. In this study, a reduced form VAR is estimated for output and prices and the estimated innovations in this VAR will be interpreted as aggregate supply and demand shocks, motivated by the traditional Keynesian AD-AS model view of fluctuation.

The reason for choosing changes in output (real GDP growth) and changes in prices (inflation) as variables along the lines of Bayoumi and Eichengreen (1992) instead of output and unemployment as Blanchard and Quah (1989) has to do with the fact that in the theoretical framework we use for interpretation, the AD-AS model, aggregate demand and aggregate supply are functions of output and price. A positive shock to aggregate demand (AD) causes the downward sloping curve to shift to the right, causing both output and prices to rise. As the long run aggregate supply (LRAS) curve reaches the natural level of production, output level is no longer able to meet the demand, as a result prices rise even higher. Therefore, demand shock has a transitory effect on real output and price level, also a permanent effect on prices but no permanent effect on output. In the short run, a positive supply shock causes the upward sloping curve (SRAS) to shift to the right along the demand curve (AD) and causing real output to rise and price level to fall. The same dynamic is kept in the long run (LRAS) as supply shocks unlike demand shocks do have a permanent influence on output. We notice that demand and supply disturbances have opposite effects on prices, whether they are permanent or just transitory.

Using the impulse response functions (IRF) generated from an inflation-output VAR to calculate the dynamic effects of a shock to inflation and a shock to output is the common intuition when it comes to study the effect of shocks on the economy. However, it will be more realistic to consider that the shocks generating inflation and output are an aggregate supply shock and an aggregate demand shock and that both of these shocks have a direct effect on both inflation and output. Then, the procedure for decomposing the shocks in order to separate aggregate supply shocks from aggregate demand shocks, as well as their impulse response begins by supposing that structural shocks and reduced-form VAR shocks are related. Bayoumi and Eichengreen's (1992) representation links the influence of output and prices to each other, assuming that ε_t is a vector of serially uncorrelated white noise disturbances that represent unexplained components in output growth and inflation movements, thus interpreted as structural shocks. They can be written as linear combinations of supply and demand shocks:

$$e_t^Y = c_{11}\varepsilon_t^{YD} + c_{12}\varepsilon_t^{YS} \quad (1)$$

$$e_t^P = c_{21}\varepsilon_t^{PD} + c_{22}\varepsilon_t^{PS} \quad (2)$$

In matrix form, we have $e_t = C\varepsilon_t$, where ε_t^{YD} and ε_t^{PD} represent the part of the disturbances that is explained by demand shocks in output growth and inflation respectively; ε_t^{YS} and ε_t^{PS} denote the part of the disturbances that is explained by supply shocks in output growth and inflation respectively. In order to identify the structural shocks, we have to estimate first a structural vector autoregressive (SVAR) model derived from the chosen underlying economic theory. It is likely that there are contemporaneous interactions between variables, thus we shall consider the following bivariate dynamic simultaneous equations for output and price level:

$$Y_t = \varphi_{01} + a_{12}P_t + \sum_{k=1}^{n} b_{11k}Y_{t\text{-}k} + \sum_{k=1}^{n} b_{12k}P_{t\text{-}k} + e_t^Y \quad (3)$$

$$P_t = \varphi_{02} + a_{21}Y_t + \sum_{k=1}^{n} b_{21k}Y_{t\text{-}k} + \sum_{k=1}^{n} b_{22k}P_{t\text{-}k} + e_t^p \quad (4)$$

$$\begin{bmatrix} 1 & \text{-}a_{12} \\ \text{-}a_{21} & 1 \end{bmatrix}\begin{bmatrix} Y_t \\ P_t \end{bmatrix} = \begin{bmatrix} \varphi_{01} \\ \varphi_{02} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{n} b_{11k} & \sum_{k=1}^{n} b_{12k} \\ \sum_{k=1}^{n} b_{21k} & \sum_{k=1}^{n} b_{22k} \end{bmatrix}\begin{bmatrix} Y_{t\text{-}k} \\ P_{t\text{-}k} \end{bmatrix} + \begin{bmatrix} e_t^Y \\ e_t^P \end{bmatrix} \quad (5)$$

Let $X_t = (Y_t, P_t)'$ denote the vector of endogenous variables where Y_t is the real GDP growth and P_t is the inflation rate. The dynamic structural representation of the model is written as follows:

$$AX_t = \varphi + \sum_{k=1}^{p} B_k X_{t\text{-}k} + e_t \quad (6)$$

Where $A = \begin{bmatrix} 1 & \text{-}a_{12} \\ \text{-}a_{21} & 1 \end{bmatrix}$; φ is a vector of constants; B_k represents a 2x2 matrix of structural coefficients and e_t denotes a vector of serially uncorrelated structural shocks with $E(e_t e_t') = \begin{pmatrix} E\left(e^{Y^2}\right) & E(e^Y e^P) \\ E(e^Y e^P) & E\left(e^{P^2}\right) \end{pmatrix} = I$ as the covariance matrix. However, because the disturbances are uncorrelated and independent from each other, it makes it difficult to obtain unbiased estimates using the structural form. Consequently, we need to transform the model by multiplying equation 3-4 by A^{-1}we obtain the reduced VAR to be estimated:

$$X_t = \gamma + \sum_{k=1}^{p} C_k X_{t\text{-}k} + \mu_t \quad (7)$$

Where $\gamma = A^{-1}\varphi$; $C_k = A^{-1}B_k$; $\mu_t = A^{-1}e_t$ and the covariance matrix for the reduced form VAR shocks is $E(\mu_t \mu_t') = A^{-1}E(e_t, e_t')A^{-1\prime} = A^{-1}A^{-1\prime} = \Sigma$. Thus the observed covariance structure gives us some information about their relation to the structural shocks. Therefore, in order to calculate long-run effect of a given shock on one of the variables, let say Y_t for instance, we calculate the sum of its effects on ΔY_t , ΔY_{t+1} , ΔY_{t+2} and so on. That is to say, the long-run effect of a shock corresponds to the sum of the impulse responses from p periods. We shall then consider the impulse responses for $Z_t = (\Delta Y_t, \Delta P_t)'$ where ΔY_t is the change in output, and ΔP_t is the change in prices. The moving average representation of the model is written as follows:

$$Z_t = \mu_t + B_1 Z_{t-1} + B_2 Z_{t-2} + \cdots + B_n Z_{t-n} \quad (8)$$

$$Z_t = (I + B(L) + B(L)^2 + \cdots + B(L)^3 + \cdots)\mu_t \quad (9)$$

$$Z_t = (I - B(L))^{-1}\mu_t \quad (10)$$

$$Z_t = (I\text{-}B(L))^{-1}A^{-1}e_t = \theta e_t \quad (11)$$

Where $\theta = (I - B(L))^{-1}A^{-1}$, the $\theta\theta' = \left(I - B(L)\right)^{-1}A^{-1}A^{-1\prime}\left(I - B(L)\right)^{-1}$. Note that we previously defined $A^{-1}A^{-1\prime} = \Sigma$, the covariance matrix of the reduced -form shocks. Therefore, we have:

$$\theta\theta' = \left(I - B(L)\right)^{-1}\Sigma\left(I - B(L)\right)^{-1\prime} \quad (12)$$

The restriction made by Blanchard and Quah (1989) is to set θ as a lower triangular matrix, as only the supply shock has a long-run effect on the level of output.

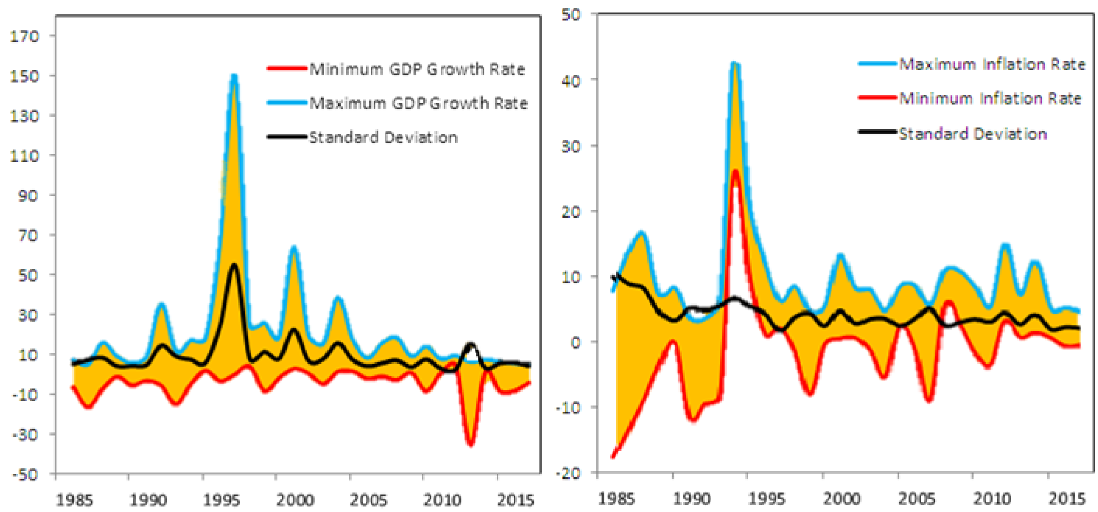
$$\theta = \begin{pmatrix} \theta_{11} & 0 \\ \theta_{21} & \theta_{22} \end{pmatrix} \quad (13)$$

Now we focus on calculating the Choleski factor of the symmetric matrix $\theta\theta'$. However, estimating the reduced-form VAR will not give us the information we need about the structure of the economy and μ_t cannot be referred to as structural shocks. Thus, in order to identifying actual structural shocks, we should use the relation $\theta = (I - B(L))^{-1}A^{-1}$ to identify A^{-1}. We previously established that $\mu_t = A^{-1}e_t$, then $e_t = A\mu_t$. Finally, we calculate the impulse response functions to the structural shocks.

4. Data Description and Preliminary Tests

4.1 Data Description and Sources

When a macroeconomic shock occurs, there is a need for adjustment. There exist two types of adjustment: real or nominal adjustment. Real adjustment happens through quantities, depicted by variables such as output growth and unemployment rate. On the other hand, for adjustment to be qualified as nominal, it should take place through prices, better measured by variables such as interest rate, exchange rate and inflation rate. Therefore, in order to isolate country-specific shocks that are not the result of innovation in monetary policy, but provoked by exogenous aggregate supply and aggregate demand shocks we chose to identify shocks to output growth and inflation. Hence, those variables represent the most important macroeconomic indicators across African countries as stated by Dhonte et al. (1993). Different preferences about inflation and output growth of countries may make the introduction of a common currency costly. A high inflation country will progressively lose its competitiveness by sharing a common currency with a lower inflation country. The same goes with a fast-growing country having to implement deflationary policies, in order to constrain growth, if it forms a monetary union with a slow-growing country. This motivates the comparative analysis of inflation and output growth across CAEMC member states.



Source: Author's elaboration using World Bank Development Indicators database

Figure 1. Output Growth and Inflation Dispersion in CAEMC Countries

The sample of annually data covers the period from 1986 to 2017 for the six CAEMC member states (Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea and Gabon). It consists of national indicators that can directly explain aggregate supply and aggregate demand fluctuations according to the theoretical framework discussed in section 3, namely real GDP growth and inflation rate. Data are sourced from the World Bank indicators, IMF's World Economic Outlook and Bank of Central African States. However, the World Bank is the main source for real GDP growth and prices data series. As displayed in Figure 1, the inflation rate dispersion and growth rate dispersion standard deviation curves have a peak in 1986 and 1997 respectively. It appears that a movement of convergence might exist in the case of inflation with a standard deviation that follows a descending trend, going from 9.89 at the beginning of the sample to 1.65 by the end of the sample. However it is more difficult to observe a movement of convergence in the case of real GDP, because the standard deviation curve does not seem to follow a trend.

Then, we analyze the correlation of output growth and inflation across countries. Tables 1 and 2 display the correlation matrices of output growth and inflation. By observing cross-country coefficients of correlation, we observe that for inflation, correlations are high and only Cameroon and Equatorial Guinea display less than sixty percentage of correlation, confirming the movement of convergence previously observed in Figure 1. However concerning output growth, coefficients of correlation for any pair of countries are very low and even negative, again in concordance with the graph displayed in Figure 1. These results could suggest the presence of costs for a monetary union in Central Africa already. Therefore, SVAR estimation and identification of structural macroeconomic shocks within the CAEMC will help in further assessing the optimality of the monetary union.

Table 1. Correlation Matrix of Output Growth

Correlation Prob.	*Cameroon*	*C.A.R.*	*Chad*	*Congo*	*Eq. Guinea*	*Gabon*
Cameroon	**1** -----					
C.A.R.	**0.093** (0.61)	**1** -----				
Chad	**0.220** (0.22)	**0.035** (0.84)	**1** -----			
Congo	**0.069** (0.70)	**-0.057** (0.75)	**0.352** (0.04)	**1** -----		
Eq. Guinea	**0.196** (0.28)	**0.110** (0.54)	**0.184** (0.31)	**-0.031** (0.86)	**1** -----	
Gabon	**-0.113** (0.53)	**0.033** (0.85)	**0.220** (0.22)	**0.103** (0.57)	**-0.009** (0.95)	**1** -----

Note. The numbers in brackets are p-values.

Source: Author's computation of time series variables.

Table 2. Correlation Matrix of Inflation

Correlation Prob.	*Cameroon*	*C.A.R.*	*Chad*	*Congo*	*Eq. Guinea*	*Gabon*
Cameroon	**1** -----					
C.A.R.	**0.606** (0.00)	**1** -----				
Chad	**0.662** (0.00)	**0.611** (0.00)	**1** -----			
Congo	**0.868** (0.00)	**0.739** (0.00)	**0.700** (0.00)	**1** -----		
Eq. Guinea	**0.457** (0.00)	**0.733** (0.00)	**0.694** (0.00)	**0.651** (0.00)	**1** -----	
Gabon	**0.765** (0.53)	**0.752** (0.00)	**0.494** (0.00)	**0.831** (0.00)	**0.640** (0.00)	**1** -----

Note. The numbers in brackets are p-values.

Source: Author's computation of time series variables.

4.2 Unit Roots and Cointegration Tests

Stationarity is a part of the Gauss-Markov conditions for unbiased efficient regression estimators in order to avoid spurious results. To be more specific, when applied to non-stationary data, analysis can inadequately lead to insignificant estimates that appear to be meaningful as stated by Granger and Newbold (1974), and supported by Hamilton (1994). Note that a stationary series is one whose basic statistical properties (mean, expectancy, variance, etc.) do not change over time. In contrast, a non-stationary series has one or more basic properties that do change over time.

The Dickey-Fuller test is traditionally used to test for non-stationarity and in the case a unit root is found, differencing the data is the easiest way to induce stationarity. In section 3, we did assume that $X_t = (\Delta Y_t, \Delta P_t)'$ represents the vector of changes in real output growth ΔY_t and the change in price levels (inflation) ΔP_t. Therefore, in order for us to be able to write a dynamic structural representation of the model, $X_t = (\Delta Y_t, \Delta P_t)'$ should be I(0). Thus, the tests for unit root were performed at level. A deterministic trend is not included in the specification for all the series which are tested for stationarity, nor an intercept as the graphs in Figure 2 appear to be flat and potentially slow-turning around zero.

Besides, before performing Augmented-Dickey Fuller (ADF) and Philip Perron (PP) unit root tests, autocorrelation of residuals shall be avoided as it biases the standard errors (t-values, F-tests) of estimates by selecting optimal lags. For annual data, the number of lags is typically small, 1 or 2 is enough to guarantee non-residual autocorrelation in such case. The different information criteria tested are the Akaike information Criterion (AIC), the Schwarz Information Criterion (SC) and the Hannan-Quinn Information Criterion (HQ). The Akaike Information Criterion, which was the criterion with the smallest value among all the other criteria, indicated that all of the models had an optimal lag length of zero to two. The results displayed in Table 3 show that variables are all considered stationary I(0) at 1% level of significance using both tests, except for Cameroon's GDP growth which is considered stationary at 5% level of significance. Results reported in table 4 using Pedroni panel cointegration test, show that the variables are not cointegrated.

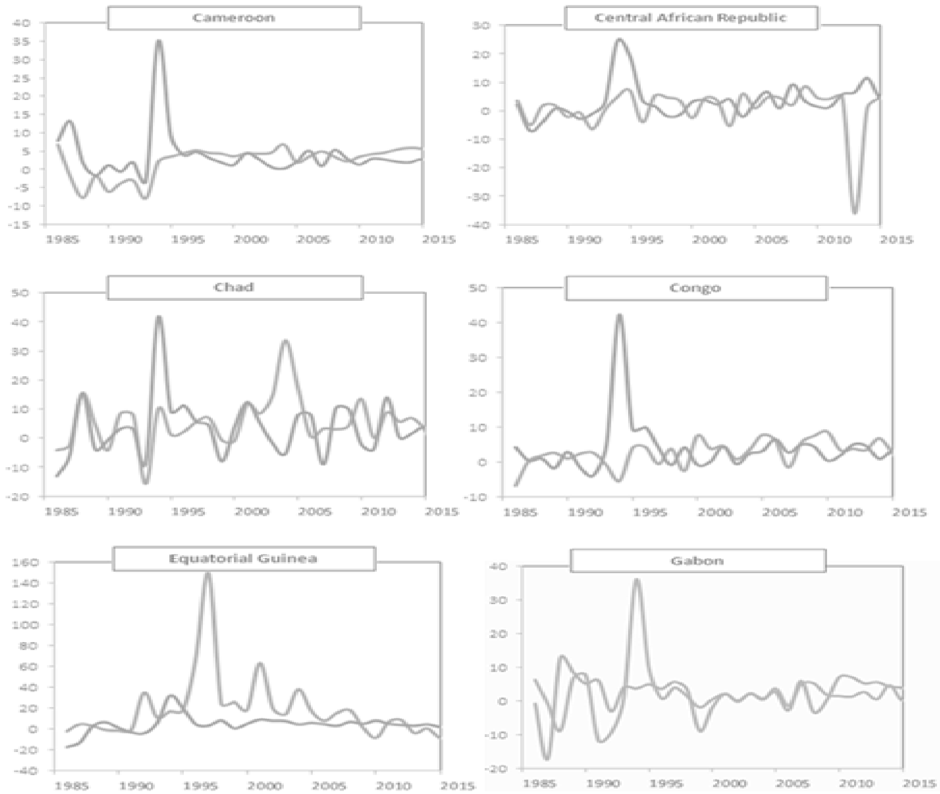


Figure 2. Output Growth and Inflation Graphs for CAEMC Countries

Source: World Bank Indicators.

Table 3. Unit Root Tests

Countries	Output Growth		Inflation	
	ADF	PP	ADF	PP
Cameroon	-**2.31**(0)	-**2.51**(4)	-4.19(0)	-4.17(2)
C.A.R	-5.70(0)	-5.77(4)	-2.71(0)	-2.77(2)
Chad	-3.49(0)	-3.62(4)	-5.48(0)	-5.48(3)
Congo	-3.42(0)	-3.41(1)	-3.75(0)	-3.75(2)
Eq. Guinea	-2.91(0)	-2.86(1)	-2.98(0)	-2.97(5)
Gabon	-4.76(0)	-4.76(2)	-4.42(0)	-4.35(11)

Source: Author's Computation from time series data.

Notes.

a. The critical values are -2.64, -1.95 and -1.61 for 1%, 5% and 10% level of significance respectively

b. Bold figure indicate cases where the null hypothesis of the presence of a unit root is rejected at 5% level of significance

c. The number in parentheses denotes the number of lags used for the ADF test, and the bandwith (Newey-West automatic) for the PP test.

Table 4. Cointegration Tests

Test	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	0.90504	0.18270	1.67232	0.04720
Panel rho-Statistic	-7.70323	0.00000	-8.95349	0.00000
Panel PP-Statistic	-5.28695	0.00000	-6.43495	0.00000
Panel ADF-Statistic	-5.32226	0.00000	-6.16211	0.00000

Source: Author’s Computation from panel data.

Notes.

a. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution

b. Probabilities < 0.05 indicate that the null hypothesis that the variables are cointegrated is rejected.

5. Svar Estimaton and Identification of Structural Shocks

5.1 Dynamic Effects of Structural Shocks

In this study, we use a two-variable VAR for real GDP growth and inflation rate in levels form. The estimated VAR is stationary in the case of each country and zero long-run restrictions have been imposed on the matrix of long-term effects of aggregate demand shocks. The aggregate demand is restricted not to have a permanent effect on output, as long-run output depends entirely on supply factors. However, no restriction is imposed on the long-term effect of supply disturbances on output and price level. We obtain the identified shocks by applying the transformation of section 3 to the reduced form VAR residuals.

Figures 3 and 4 below show output growth and inflation reaction to aggregate demand shocks in the CAEMC respectively. For all the countries in the CAEMC, output level has fallen due to adverse demand shocks. We notice that in general, dynamic effects of demand disturbances reach their lowest point after two years in the case of Chad, three years for the Central African Republic, four years in the case of Cameroon, Congo, Benin and finally five years for Equatorial Guinea. The disturbances vanish afterwards most of the time except in the case of Congo where we observe some effects up until ten years following the impact of the macroeconomic shock. Changes in aggregate demand always push inflation and output growth in the same direction. This is the case here when price level reacts in accordance with our theoretical framework, meaning it moves following the same direction than the output level. However, there is a puzzle in the case of Equatorial Guinea, because output and price are not moving in the same direction as first sight like the theory suggests in case of aggregate demand shock. Nonetheless, we chose to interpret this particular shock as a demand disturbance because of the non-lasting and very little positive impact it has on the price level, immediately followed by a drop greater in amplitude from the second to the third year. In general, demand innovations have a more lasting impact on output than in prices, as it takes only between two years (the Central African Republic, Chad and Gabon) to three years (Cameroon, Congo and Equatorial Guinea) to dissipate progressively. Therefore, we can come to the conclusion that that CAEMC countries appear to have experienced a negative demand shock overall, as the output and price levels dropped altogether and in accordance with the theoretical framework we chose to explain the structural innovations in this study.

Demand shocks are associated with monetary and fiscal policy shocks (Houssa, 2008). A negative demand shock can create a recessionary gap, meaning that it can create a shortage in output and unemployment as a consequence. Besides, fiscal policy is closely related to terms of trade shocks in developing countries, meaning that negative terms of trade led to fiscal crises caused by cuts in government expenditure. The reduction of government spending, in the context of fiscal consolidation, aims to diminish public deficit and government debt. Nonetheless, it does negatively influence aggregate demand in the context of sticky prices as predicted by traditional Keynesian models. Also, the negative demand shocks illustrate the negative effect of monetary policy on CAEMC economies.

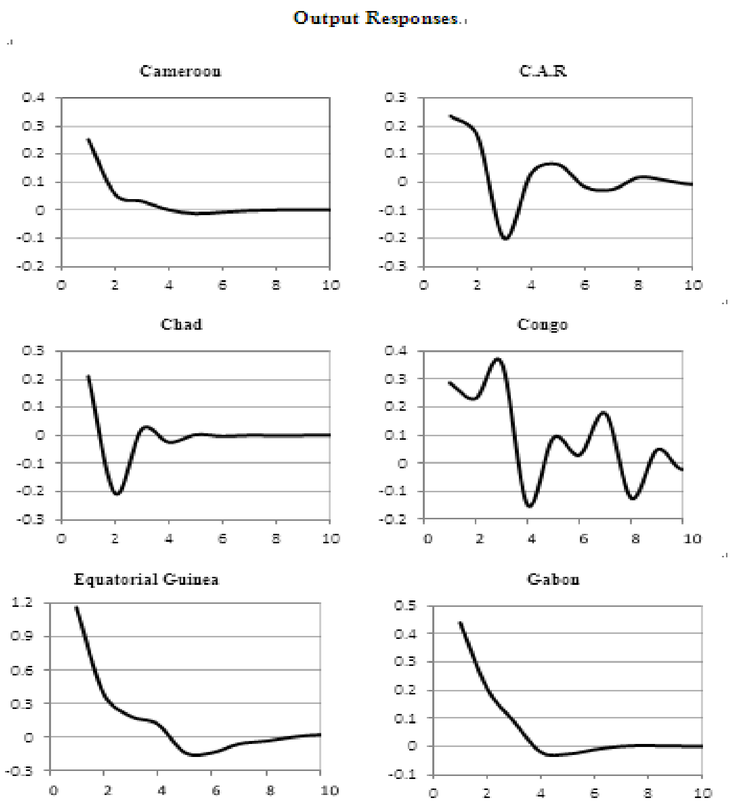


Figure 3. Output Response to Demand Shock

Source: Author’s elaboration using estimation results.

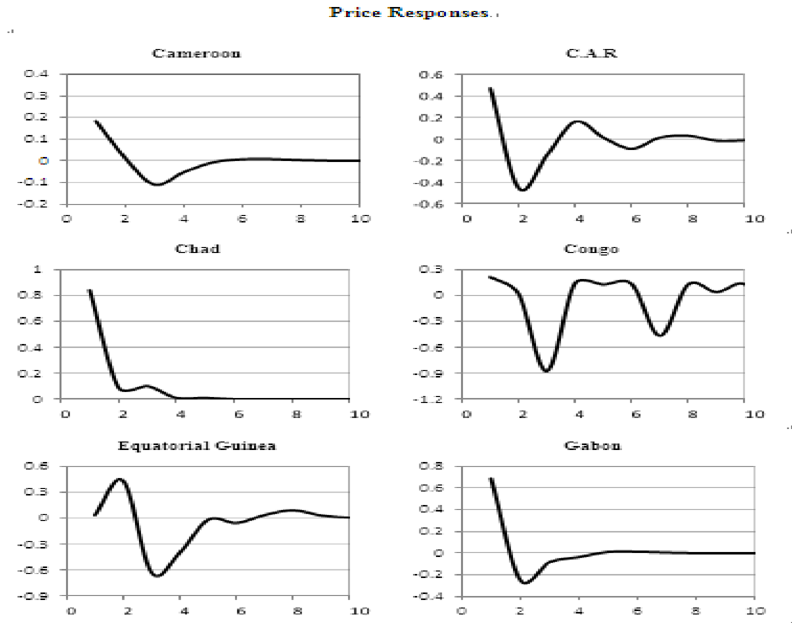


Figure 4. Price Response to Demand Shock

Source: Author's elaboration using estimation results.

In fact, although devaluation in 1994 had an immediate positive effect on CAEMC countries aggregate demand, as well as the depreciation of the CFA franc against the euro in 2000 as displayed in Figure 5, it did not last long as one could have expected. Furthermore, the presence of excess liquidity in the banking system does not help improving member states' aggregate demand either, as demonstrated by Saxegaard (2006) while studying CAEMC countries.

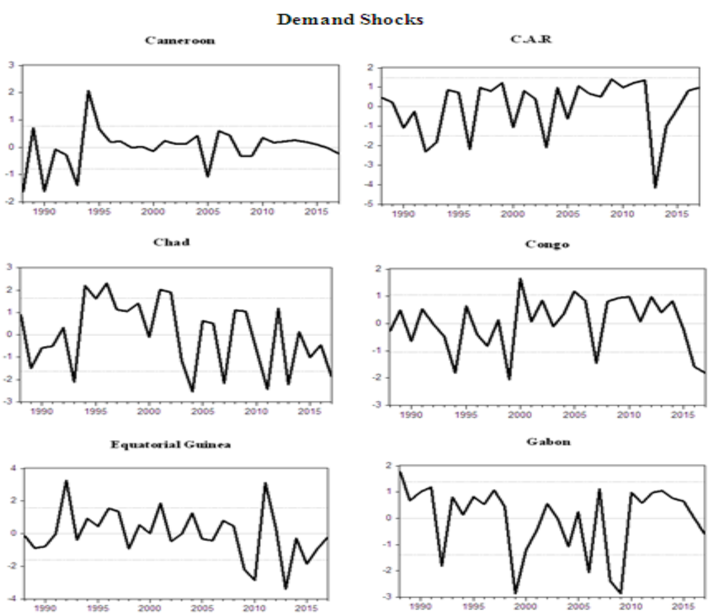


Figure 5. Aggregate Demand Shocks Fluctuations in CAEMC, 1986-2017

Source: Author's elaboration using estimation results.

In the case of aggregate supply shocks, Figures 6 and 7 display the dynamic responses of each variable to the shocks and show that except for Chad, CAEMC member states experienced a positive aggregate supply shock during the sample period. We observe increased output and price level stability at the same time. The main characteristic that allows us to identify it as an aggregate supply shock is that output and price moves in opposite direction as described by the theory. For the Central African Republic and Congo the effects of supply disturbances on output reach their peak two years following the shock, as well as its trough in the case of Chad. For Cameroon, Equatorial Guinea and Gabon, the peak is reached after three years. Supply disturbances effects on price are pretty similar than their effects on output in terms of duration as most of the countries reach their trough between the second year and the third year following the impact. However, in the case of Chad, we observe a sharp rise in price level and stabilization happens until five years after impact. Likewise demand shocks, supply innovations have a long-lasting impact in the case of Congo, up until ten years following macroeconomic shocks.

An important observation we make here is that for none of the countries in the region, the identified supply shocks does seem to exert a permanent impact on output level. There is neither a steady increase nor decrease, but rather a contemporaneous reaction of the variable to the shock that gradually returns to its baseline level after two to three years, despite the zero long-run restriction imposed previously. This situation can be explained by the temporary nature of the supply disturbances that affect those sub-Saharan economies as noticed by Bayoumi and Ostry (2010). They observe that in Africa, many of the shocks which affect economies are temporary supply disturbances such as climatic shocks to agriculture or terms of trade disturbances. As a matter of fact, CAEMC countries are developing economies that are structurally different from developed countries because the dominant sector in the economies of member states is subsistence agriculture.

Positive supply shocks are good news for an economy, because the country is experiencing growth in the context of increased output and price level stability. In the case of Chad however on top of experiencing negative demand shocks, the economy is also subjected to adverse supply shocks. In this particular case, Chad did experience a cost push inflation meaning an adjustment in price level following a recessionary gap, meaning a decrease in national output. This can cause a rise in unemployment.

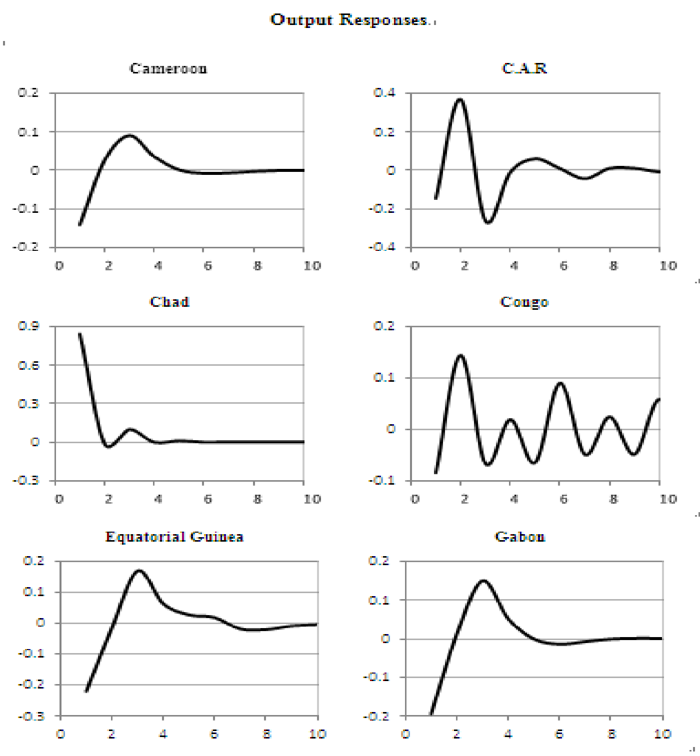


Figure 6. Output Response to Supply Shock

Source: Author's elaboration using estimation results.

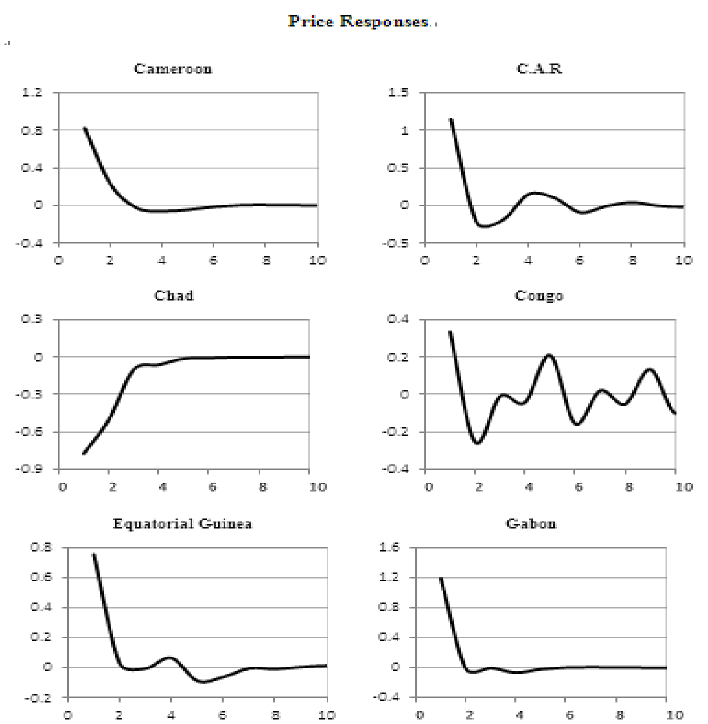


Figure 7. Price Response to Supply Shock

Source: Author's elaboration using estimation results.

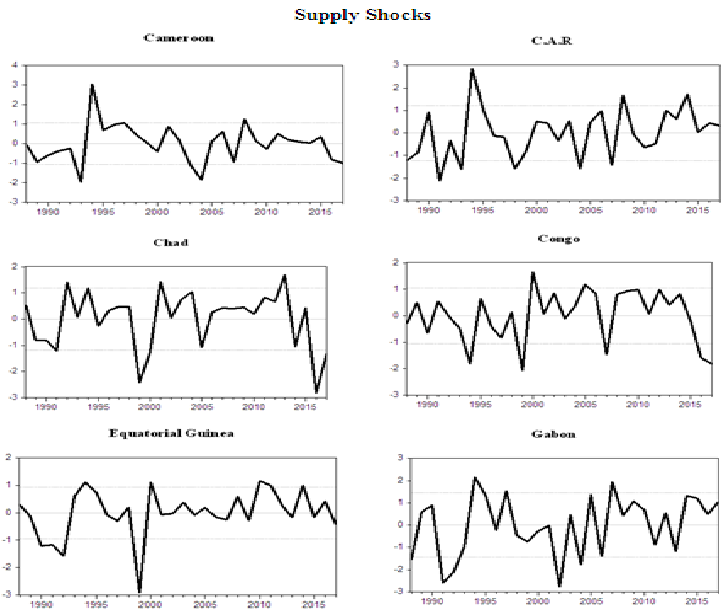


Figure 8. Aggregate Supply Shocks Fluctuations in CAEMC, 1986-2017

Source: Author's elaboration using estimation results.

The present impulse response analysis is informative in order to identify the nature of the shocks, but incomplete. Concerning the amplitude of the disturbances and their real impact on CAEMC countries, we need further observation. However, from this stage, we can already identify an outlier that is Chad which did experienced both adverse demand and supply shocks when the other member states did experiment negative demand shocks and positive aggregate supply shocks, during the sample period. Further investigation in the next sections will measure the amplitude of the impact as well as the degree of shock asymmetry across countries in the union.

5.2 Contribution of Demand and Supply Disturbances

Table 5. Variance Decomposition

Country	Variable	Shock	Time Horizon				
			1	2	4	8	20
Cameroon	Output Growth	*Demand*	**76.40**	**76.63**	**69.51**	**69.51**	**69.51**
		Supply	23.60	23.37	30.49	30.49	30.49
	Inflation	*Demand*	4.73	4.42	6.21	6.21	6.21
		Supply	**95.27**	**95.58**	**93.79**	**93.79**	**93.79**
C.A.R	Output Growth	*Demand*	**72.84**	34.57	35.49	35.90	35.90
		Supply	27.16	**65.43**	**64.51**	**64.10**	**64.10**
	Inflation	*Demand*	14.31	23.72	24.91	25.01	25.02
		Supply	**85.69**	**76.28**	**75.09**	**74.99**	**74.98**

Chad	Output Growth	*Demand*	5.84	10.90	10.88	10.88	10.88
		Supply	**94.16**	**89.10**	**89.12**	**89.12**	**89.12**
	Inflation	*Demand*	54.38	45.83	45.80	45.80	45.80
		Supply	45.62	54.17	54.20	54.20	54.20
Congo	Output Growth	*Demand*	**92.12**	**83.00**	**89.78**	**87.75**	**86.14**
		Supply	7.88	17.00	10.22	12.25	13.86
	Inflation	*Demand*	29.30	21.08	**82.37**	**81.52**	**80.69**
		Supply	**70.70**	**78.92**	17.63	18.48	19.31
Eq.Guinea	Output Growth	*Demand*	**96.55**	**96.88**	**95.04**	**95.05**	**95.05**
		Supply	3.45	3.12	4.96	4.95	4.95
	Inflation	*Demand*	0.27	24.87	56.29	56.25	56.29
		Supply	**99.73**	**75.13**	**43.71**	**43.75**	**43.71**
Gabon	Output Growth	*Demand*	**83.77**	**86.27**	**79.64**	**79.64**	**79.64**
		Supply	16.23	13.73	20.36	20.36	20.36
	Inflation	*Demand*	25.09	27.51	27.75	27.76	27.76
		Supply	**74.91**	**72.49**	**72.25**	**72.24**	**72.24**

Source: Author's computation from time series data

Note. Bold figures denote that the influence of the shock is at least 30 percent greater than the other.

After identifying the nature of the shocks that impacted output growth and inflation in the CAEMC, we proceed on measuring their size and magnitude. Variance decomposition helps determine whether the sources of shock to variables in the models are the same across the region by identifying the sources of variability for each variable in the models for different member states. Table 5 displays the proportion of real output growth and inflation rate variance explained by supply and demand shocks for Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea and Gabon. Time horizon for our observation goes from 1 to 20 years, in order for us to be able to compare the model structure for each country.

For all the countries of the region except for Chad, demand shocks dominate variability in output growth explaining up to 96 percent of output variance. The amplitude is greater in countries like Congo, Equatorial Guinea and Gabon than in Cameroon and the Central African Republic. On the other hand, supply innovations are a more significant source of short-run inflation rate fluctuation up to 99 percent of inflation variance, once again with the exception of Chad. Therefore, results displayed in table 5 below suggest that the sources of external shock to real GDP growth and inflation rate are common to all the countries in the region except for Chad. Macroeconomic shocks of different nature, while influencing the same variable, suggest different directions for the variables. For instance, an adverse demand shock suggests a decrease in the output level, while a positive supply shock suggests the opposite. Likewise, an adverse demand shock may put a downward pressure on price level, while a negative supply shock suggests a rise. Then, variance decomposition allows us to sort out those contradictions and determine which shock has the most influence on the said variable, so as to determine definitively in which direction the variable follows.

Several scenarios stand out in our study case. Cameroon and Gabon satisfy the first case scenario where output growth is unambiguously influenced by negative demand disturbances, therefore causing the downward pressure on output to efficiently cause output level to decrease from 69.51 to 76.40 percent in the case of Cameroon and 79.64 to 80.77 percent for Gabon. Likewise, inflation is unambiguously influenced by a positive supply disturbance, causing stabilization in the price level from 93.77 to 95.27 percent for Cameroon and 72.24 to 74.94 percent for Gabon. The second case scenario concerns Congo and Equatorial Guinea. Here, output growth is also best explained by adverse demand shocks, therefore causing a fall in output level from 86.14 to 92.12 percent for Congo and from 95.05 to 96.55 percent for Equatorial Guinea. For price level, positive supply shocks have a great influence at impact (70.70 percent for Congo and 99.73 percent for Equatorial Guinea), up to the second year following the impact (78.92 percent for Congo and 75.13 percent for Equatorial Guinea). However, from the third year upwards, negative demand shocks gain more influence in the explanation of variation in price for more than 80 percent in the case of Congo and more than 56 percent in the case of Equatorial Guinea. But as negative demand disturbances and positive supply disturbances both put a downward pressure on price, inflation is declining in both countries. The last case scenario is a little tricky, because one variable is unambiguously influenced by one type of shock, while the other variable undergo shocks of different nature which have a significant impact at different time periods or even at the same time, thus putting pressure on opposite directions. This is the case for the Central African Republic, where negative demand holds more weight on output growth than the positive supply disturbance a year following the impact (72.84 percent), causing a fall on the output at first. But starting the second year until twenty years after impact, output is better explained by positive supply innovations causing a rise on output (more than 60 percent). However, price level is stabilized as positive supply disturbances unambiguously influence this variable from 74.98 to 85.69 percent. Lastly in the case of Chad, price is almost equally explained by the negative demand shocks which causes price to fall and counterbalanced by positive supply shocks which causes price to rise, thus limiting deflation threat. Yet, output growth is unambiguously influenced by negative supply shocks, causing the fall in output level from 89.12 to 94.16 percent.

6. Concluding Remarks

Our study aims to identify macroeconomic shocks within the CAEMC, in order to determine whether or not the currency area is exposed to asymmetric shocks, threatening its optimality. First, by observing output growth and inflation impulse responses to structural shocks, we conclude that all the CAEMC countries are hit by adverse demand shocks, causing output and price to move in the same direction. Five of them, except for Chad, experience positive supply shocks during our sample period. Then, for nearly all the countries within the CAEMC, variance decomposition shows that in accordance with the proportion of variance explained by different shocks, output level is decreasing, except for the Central African Republic where from the second year following impact to the 20th year, output level is increasing mostly influenced by positive supply shocks. Besides, the proportion of variance in Chad's output growth is explained by adverse supply shocks rather than adverse demand disturbances for Cameroon, Congo, Equatorial Guinea, Gabon on one hand, and the Central African Republic the first year after the shock.

If the Central African Republic do not seem to suffer a lot from adverse demand shocks, as revealed by variance decompositions, Chad appear to be an outlier in the case of aggregate supply being the only country in the region to experience negative supply shocks. Therefore, policies responses aiming to stimulate aggregate demand in order to increase real output, by decreasing interest rates for instance, would likely threaten the fragile price stability in Chad, as the downward pressure of negative aggregate demand shocks is currently counterbalancing the rising inflation rate, caused by the negative supply shocks faced by this economy. There is no easy answer to this situation. Yet, the BEAC has pursued a restrictive monetary policy over the past three years and raised the interest rates to 3.5 percent aiming at maintaining the parity rate between the CFA franc and its reference currency, thus avoiding devaluation. The reason local authorities were able to pursue such a policy in a global context of declining rates, may lie in the current implementation of capital controls to cope with currency crisis in the region. This explains the negative correlation between domestic and foreign real interest rates movements since quantitative restrictions on international capital flows sever any direct link, as demonstrated by Greenwood and Kimbrough (1985). Besides, the presence of excess liquidity in the banking system weakens the monetary transmission mechanism and thus the ability of monetary authorities to stimulate aggregate demand, as demonstrated by Saxegaard (2006) in the case of CAEMC member states.

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Notes

Note 1. Along with the Central African Economic and Monetary Community (CAEMC), the West African Economic and Monetary Union (WAEMU) is part of the CFA franc zone. In this study, our analysis will mainly focus on the CAEMC.

Note 2. BEAC (Bank of Central African States) is the central bank of CAEMC member states.