What is different about macroeconomic interactions in the African CFA zone ?

Resilience to a Shock of Commodity Prices

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Abstract

The CFA zone is a unique case of study because it features two peculiar aspects: its peg to the euro and its high dependence on raw commodities. These constraints could affect macroeconomic interactions in a very singular fashion. Using a PVAR model I show that CFA countries suffer more from shocks on their terms of trade than non-CFA SSA countries who use their flexible exchange rate as a shock absorber. Moreover, the results fail to show a loss of competitiveness due to a currency appreciation within the CFA area. Finally, foreign investor attractiveness seems to be hindered by a resource curse.

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Introduction

Two African economic and monetary communities are using the CFA franc as a currency since 1945. Eight countries, namely Benin, Burkina Faso, Ivory Coast, Guinea-Bissau, Mali, Niger, Togo and Senegal belong to the 'West African Economic and Monetary Union' (WAEMU). Six countries, namely Cameroon, Central African Republic, Chad, Republic of Congo, Equatorial Guinea and Gabon belong to the 'Central African Economic and Monetary Community' (CEMAC). In the recent years, extensive literature (Bénassy-Quéré and Coupet 2003; Karras 2007; Tabsoba 2008; Debrun, Masson and Patillo 2005; Gnimassoun 2012; Loreiro, Martin and Riviera 2012; Couharde, Coulibaly and Damette 2013; Cowherd *et al.* 2013; Gnimassoun and Coulibaly 2014) have stressed the poor match of the CFA zone with the optimal currency area criteria (Mundell 1961). Today, the debat lays beyond the question of the so called optimum curency area criteria. At the core of my analysis, I focus on two characteristics of the CFA zone that make it a unique case of study. First characteristic: the CFA zone is a specific currency area because it is pegged to another currency, namely the euro since 1999 (previously the French Franc since 1945). Second characteristic: I show that the CFA members' economies rely heavily on raw commodities. These characteristics and their impact on economic growth have been usually studied separately in the literature. Regarding the first characteristic - the peg of a currency area: economic theory highlights the two types of consequences for governments that cannot rely on an autonomous monetary policy. On the short term, it makes it difficult to address unexpected shocks on terms of trade for instance and could create an inherent instability in the case of a poor synchronization of business cycles between the pegged economy and the reference economy (notably for CFA: Loreiro, Martin and Ribiero 2012; Nabukpo 2015). On the longer run, the loss of monetary policy can be an issue to address long-term imbalances such as overvaluations. These overvaluations are usually associated with permanent deviation from equilibrium, less sustainaible current accounts or slower economic growth (amongst others, Razin and Collins 1997; Rodrick 2008). Couharde, Coulibaly and Damette (2013) and Coulibaly and Gnimassoun (2014) came to the similar conclusions using data from the CFA zone. Ramirez and Tsangarides (2007) insist in the competitiveness issue in the pegged CFA zone. Regarding the second characteristic - high dependence on raw commodities - there exists an extensive literature following the definition of the 'natural resource curve'[1] by Auty (1993). According to this theory, countries endowed with natural resources do experience a lower economic growth compared to countries with low or no natural resources[2]. One of the major center of interest in the literature is the poor response to government following a shock on international commodity prices. In a nutshell, according to this theory, developing countries are not able to reap the benefits of an increase of the price of commodities. These countries would tend to consume profits associated to booms rather than saving or investing it (Cashin et al. (2004) showed that positive shocks on trade balance would be associated, in the 1970s, with higher public investments essentially based by higher imports). On the contrary, when prices fall, direct looses cannot be avoided and growth is negatively impacted. This calls for a potential asymmetry of the impact of prices on growth: downswing should be more marked than upswings. Dehn (2000) provided some evidence for this phenomenon using SSA data. However, a later study by Addison, Ghoshray & Stamatogiannis (2015) fails to find evidence for asymmetry in the case of SSA countries. Moreover, consequences of drop in international prices may not be exclusively economic. Bruckner and Ciccone (2010) show

[1]Note that an alternative conventional view ("no curse") is also present in the literature and tends to show that "despite the difficulties [commodity price increases] may bring good for the economies of Africa" (Deaton, 1999)

[2]evidence from Sachs and Warner (1995) for decades 1970-80s

that outbreak of civil wars are more likely after a drop in the international price of countries' main export commodities. Finally, Guillaumont and Combes (2000) insist on vulnerability introduced by the price volatility of commodities, especially for low-income countries.
Both the impact of the peg and the impact of the high dependence on raw material have been separately studied in the case of the CFA zone. Yet, they have not been studied together in a single analysis[3]. This is the ambition of this paper. As a matter of fact, some conclusions that could hold on these separate analysis may not hold anymore when both characteristics are combined. As an illustration, let's recall that raw commodities are often priced in dollars. As a consequence, if countries are heavily dependent on raw commodities for their exports, a rise of the REER may not affect international competitiveness as one would expect. This is especially true if the production of these raw commodities depends on imported inputs labeled in dollars (let's say agricultural machinery). In this specific case, an appreciation of the CFA, through an appreciation of the EUR/USD exchange rate, may lead to a more competitive commodity production. One does not know to what extend this price effect could be the main driver of CFA exports.

Overall, when looking at the literature about the CFA zone, most approaches focus on the long term perspective. In fact, regarding the CFA zone, authors debate over the positive impact of the peg[4](economic stability, FDI attractivity, low inflation) and its negative impacts (lack of business cycles synchronization between the eurozone and the pegged area, persistence of exchange rate misalignements). If this debate tend to converge over the idea that the CFA area is not optimal but rather sustainable (Couharde *et al.* 2013), the literature often fails to zoom into the short to middle term impact of the peg. Hence the central question of this paper: given the constraints of the peg and the high dependance on raw commodities, is the CFA zone able to address on the short run the shocks on its terms of trade? This question calls for an underlying interrogation: to what extend are macroeconomic interactions different in the CFA zone? To find these answers, I study the interactions between macroeconomic variables: namely external (trade balance) and internal balances (GDP), real exchange rate and investor attractiveness (FDI). These interactions are explored in the light of shocks on terms of trade as well as the volatility of these terms. PVAR modelization have been used for comparable analysis but in different geographical context. Let's refer, amongst others, to: the study of macroeconomic imbalances in the eurozone (Gnimassoun and Mignon 2016), the domination of shocks generated outside a country on domestic variables (Canova and Pappa 2004), the relevance of fiscal and monetary interactions (Canova and Pappa, 2007) or the channels of transmission to international shocks (Ciccarelli *et al.* 2012). If PVAR model have also been increasing popular in the CFA zone but its usage remains marginal (amongst others: Fauzel, Seethanah and Sannassee (2014) on FDI, Kuikeu (2014)'s working paper on the fiscal and monetary mix in CEMAC), yet no publication have explored macroecononomic interactions with a special focus on terms of trade. This paper aims to fill this gap in the literature. To the best of my knowledge, it is the first to use a PVAR model to investigate the macroeconomic interactions in the CFA zone taking into account the high dependence on raw commodities. This is why I construct and enrich the PVAR modelization with a proxy for terms of trade of the main traded commodities.

[3]Sissoko and Dibooglu (2006) is a notable exception but considers the entire SSA zone as comparable to the CFA members.

[4]especially following the papers of Sachs and Warner 1997; Rodrick 1998

Main findings Based on data covering the period 1980-2015 from the IMF World Economic Outlook and from UNCTAD COMTRADE, I run a PVAR model. I find in both the CFA sample and in the comparative non-CFA samples strong causality relations over a one-year period lag between the 4 key macroeconomic variables (*ie* growth rate, current account, real effective exchange rate and foreign direct investment). Interestingly, estimates from the CFA zone stand out compared to the non-CFA sample. My first major result show that the peg makes it harder for the CFA countries to address shocks on the short to middle-term. The high dependence on raw commodities tend to make them more vulnerable compared to other SSA countries. My second key finding is that I do not find evidence for a loss of price competitiveness following a real appreciation. This is observed uniquely in the CFA zone. In other words, as opposed to non-CFA countries, one year following a REER shock, the volume effect has not overwhelmed the price effect on the trade balance. Lastly, my third finding is that FDI attractiveness pattern within the CFA zone suggests a curse of the natural resources. Positive movements in the prices of raw commodities and an improved trade balance negatively affects FDI attractiveness only in the CFA zone.

The rest of the paper is organized as follows. Section 2 presents a theoretical framework presenting previous analysis of macroeconomic interactions. Section 3 develops the empirical strategy and presents the dataset, the PVAR modelization as well as the post-estimation robustness tests. Section 4 presents the result of my PVAR model estimation. Section 5 concludes and gives policy recommendations in the light of my results.

Theoretical issues

Real exchange rate for country i is defined as follows[5]:

$$RER_i = NER_i . \frac{CPI_i}{CPI_{foreign}}$$

An extensive literature has studied the relationship between economic growth and real exchange rate on the short run. From the equation above, one can infer a few mechanical effects. On the short run, a GDP surge can lead to a higher domestic demand. This puts pressure on domestic Consumer Price Index (CPI), and Real Exchange Rate (RER) appreciates. On the longer run, a Balassa-Samuelson effect[6] can explain how growth rate, boosted by an increasing productivity of the tradable sector, leads to an appreciation of the domestic RER through a rise of domestic prices through higher wages. Nonetheless, these effects can be altered by public polices. Contingent upon the existence of an autonomous central bank, government can intervene through the Nominal Exchange Rate (NER) to stimulate growth and boost export price competitiveness. By maintaining a weak domestic nominal exchange rate, government thwarts potential real currency appreciation due to excessive inflows

[5]With *NER,* the nominal exchange rate, CPI_i the consumer price index in country i and $CPI_{foreign}$ the consumer price index abroad. Note that Real Effective Exchange Rate is determined by taking each bilateral *RER* of country i weighted by the intensity of trade between each pair of country.

[6]The Balassa-Samuelson logic explains how the wage of a barber in the streets of Lagos is lower than the one of a barber in Tokyo, and this even for a similar productivity. In short, two sectors are considered: the tradable and non-tradable sectors. When productivity raises in the tradable sector, workers get a higher wage due to higher profitability. As a consequence more workers are attracted to the tradable sector. However, considering that (i) people want and need to consume non-tradable goods, and that (ii) labor is mobile between tradable and non-tradable sectors, then wages in the non-tradable sector will increase in order to maintain the supply of non-tradable goods. To sum it up, higher productivity of tradable industry puts an upward wage pressure on workers of the non-tradable industry. In turn, this surge of domestic CPI leads to an appreciation of the RER.

which usually take the form of foreign reserves accumulation by the central bank. Haussmann, Pritchett and Rodrick (2005) demonstrated that rapid growth is often correlated with real exchange rate depreciation. Ito, Isard and Symansky (1999) proved the positive correlation between fast growth and undervalued currency in the case of Asian fast growing countries. Rodrick (2008) and then later Di Nino, Eichengreen and Sbracia (2011), Glüzmann, Levy-Yeyati and Sturzenegger (2012) and Habib, Elitza and Libvio (2016) went further by showing that not only overvaluation was harmful growth wise, but also that undervaluation was beneficial to induce growth.

However, in the case of the CFA zone, monetary policy implementation is not as straightforward. When belonging to a monetary union, a country must sacrifice its monetary policy autonomy whenever its business cycles is not synchronized with the business cycle of the union as a whole. A recent review by Loreiro, Martins and Ribeiro (2012) show that business cycles are not synchronized within both the Western and the Central African CFA Monetary Unions[7][8]. Moreover, the peg to the euro of the CFA zone introduces an additional constraint: not only the nominal exchange rate cannot be used as a tool to respond to an asymmetric output shock within the zone, but neither can it be used to respond to a symmetric output shock over the entire zone. Even if an adjustment through real factors (prices) is still possible to revert to equilibrium following a shock[9], it is slower than through the NER. My hypothesis here is that the economies belonging to the CFA zone are less resilient to an exogenous shock. Such a constrained monetary policy is not adequate to address sudden and unexpected movements on the commodity world price markets. Therefore, shocks can introduce disequilibria in the external (current account) or internal (output) balances which are persistent over time. Note that this impact is expected to be stronger as the dependency on these commodities is high and that the commodity world prices is more volatile.

Last but not least, comes the role of current account in macroeconomic interaction. According to the Marshall-Lerner theory, impact of the real exchange rate has two opposite components. On the short term, an appreciation of the real exchange rate of domestic currency lowers the cost of imported materials, leading to an expansion of the national output (price effect). On the longer run, once the prices have adjusted, a real appreciation of local currency lowers international competitiveness, leading to a fall in net exports, contributing to a fall in the aggregate demand (volume effect). To sum it up, RER usually impacts both side of GDP in opposite direction, through the trade balance: an appreciation in real term of local currency positively impacts the supply side and negatively impacts the demand side.

Overall, the structure of the economy determines which impact will overtake the other one. On the one hand, in countries with an export sector highly relying on commodities, price competitiveness is not a major issue since the price of commodities is often determined by major Commodity Stock Exchange (such as Chicago Mercantile Exchange, Winnipeg Commodities Exchange or the New York Mercantile Exchange). For these countries, I expect the positive effect of real exchange rate to be the strongest since imported capital goods and equipment used to produce commodities

[7]Loreiro, Martins and Ribeiro (2012) prove that only half of the West African Economic and Monetary Union (WAEMU) members have positive and significant correlations of their business cycles with the aggregate WAEMU cycle. Similarly, no more than a third of the Central African Economic and Monetary Community (CAEMC) countries have positive and significant correlations with the aggregate CAEMC cycle.

[8]Even if an endogenous synchronization process theorically happens over time, it remains "marginal" in the case of CEMAC (Carmignani, 2010) or "smaller among African countries" compared to an OECD sample (Tabsoba 2009)

[9]such an adjustment was observed in the CFA zone by Couharde *et al.* (2013). This is the reason why the authors consider the CFA zone more of a sustainable currency area than an optimal currency area. According to the authors, "a sustainable currency area is defined as a monetary union that impedes its members to deviate permanently from their equilibrium paths". They found evidence of sustainability by showing that real exchange rates tend to revert to their equilibrium paths.

has become relatively less expensive. One the other hand, countries with a trade balance more sensitive to price elasticity would be more impacted by a real appreciation of their currency and an eventual competitive loss. After a one year period, I expect that the volume effect overruns the price effect on these countries.

Empirical strategy

The data

Current account and output growth are extracted from the latest version of the World Economic Outlook for the period 1980-2015 (IMF) for 191 countries. Real Effective Exchange Rate (REER) data is extracted from the Bruegel database that includes 178 countries[10]. World prices of main commodities traded from and to the CFA zone are issued from UN COMTRADE database, at the notable exception of uranium price[11] derived from the Euratom Supply Agency database.

My sample includes 26 African countries that are all members of an economic union[12]:

- 14 countries from the 2 CFA monetary unions : WAEMU and CEMAC which currency is pegged to the euro
- 5 countries belonging only to the 'Economic Community of Central African States'[13] (ECCAS economic community)- and which are not CFA members
- 6 countries from the 'West African Monetary Zone'[14] (WAMZ economic community).

ECCAS and WAMZ members are a good comparison to the CFA sample. As a matter of fact, CEMAC (Central Africa CFA monetary union) countries belong to the larger economic union called ECCAS. On the West Africa side, WAMZ and WAEMU have launched discussions at the beginning of 2000s regarding an eventual merging of their communities to create a larger economic and monetary union (discussions are still on going).

I construct a price index of the main commodities exported for each country: this will be my simplified proxy for terms of trade. This way, I can study the macroeconomic interactions following an exogenous shock on the price of the main traded commodities (what I associate with the terms of

[10] As the Darvas (2012) clarifies, the REER is calculated as $REER_t = \frac{NEER_t.CPI_t}{CPI_t^{(foreign)}}$ where $REER_t$ is the real effective exchange rate of country under study against a basket of currencies of trading partners, CPI_t is the consumer price index of the country under study, $NEER_t = \prod_{i=1}^{N} S(i)_t^{w^{(i)}}$ is the nominal effective exchange rate of the country under study, which is in turn the geometrically weighted average of $S(i)_t$, the nominal bilateral exchange rate between the country under study and it trading partner i (measured as the foreign currency price of one unit of domestic currency), $CPI(i)_t$ is the customer price index of trading partner i, $w^{(i)}$ is the weight of the trading partner i, and N is the number of trading partners considered. The weights sum to one, ie $\sum_{i=1}^{N} w^{(i)} = 1$. Geometrically weignhted averages are used because it is the most frequent method in the literature.

[11] I retain the ESA 'MAC 3' new multi annual U_3O_8 price

[12] cf Appendix 1 for complete sum of the African economic communities members

[13] This Economic Community is born in 1983 and regroups 11 states: CEMAC members as well as Angola, Burundi, Dem. Rep. of the Congo, Rwanda and Sao Tome and Principe.

[14] Monetary Union project launched in 2000 regrouping 6 west African countries namely: Gambia, Ghana, Guinea, Nigeria, Sierra Leone and Liberia.

trade) both in the CFA zone and in comparable non-CFA SSA countries. Based on a COMTRADE dataset on the period 1995-2005, I determine the share of each export (*resp.* import) commodity representing more than 2 percent of total export (*resp.* total import). For sake of simplicity, I make the hypothesis that this average composition remained constant over the considered period of time: 1908-2015. For each country, I then multiply these factors by the annual price of each commodity. To do this, I rely on the UNCTAD commodity price database. As an illustration, let's take the example of Ivory Coast. I first start by filtering all exports (*resp.* imports) that represent more than 2% of the total export (*resp.* imports). Then, I select raw commodities which price are determined on international markets and which are listed in the UNCTAD database. I find out that Ivory Coast exports 32% of cocoa, 5% of rubber, 3% of gold and imports 2% of crude oil (as net percentage) and imports 5% of rice. I then save this raw commodity trade balance profile and for each year, I multiply these percentages by the price of each commodity. This is how I obtain my annual proxy for terms of trade focusing exclusively on raw commodities. Note that Deaton (1999)[15] and later Sissoko and Dibooglu (2006) have constructed a similar index. Regarding Deaton, he was assessing the existence of a resource curse in SSA. The author does not formally find evidence for a resource curse but admit volatility could be difficult to address in some context. Overall, the lack of powerful econometric tool at this time make it difficult to understand the relationship between the exogenous commodity price index and macroeconomic variables in SSA countries. This paper has the ambition to fill this gap.

As figure 5 (*cf.* appendix) illustrates, for some countries, the price evolution of a single commodity can explain most of the terms of trade proxy (ex: Mali with gold, Gabon, Congo and Cameroon with oil, Benin with cotton, Ivory Coast with cocoa) whereas some countries have a more diversified trade composition. Such a diversification attenuate the volatility of terms of trade (Deaton 1999). Overall, my proxy for terms of trade is at the same time a powerful and unique tool: it is a great way to introduce a pure exogenous factor and focus on the impact of price of raw commodities in economies which are highly depend on them. On the other hand, its simplification could also be a critic to my analysis[16].

Methodology

I study the interaction between output growth (GDP) – proxy for internal balance- , Balance of Current Account (BCA) – proxy for external balance-, real effective exchange rate (REER) and foreign direct investment (FDI). I tackle the endogeneity issue by adopting a panel vector

[15] yet he was only considering exports above the threshold of 10% of total exports

[16] One critic of this analysis could be addressed regarding the construction of the terms of trade index I construct for this paper. A key input of my paper and its explanatory power in the model I use, is very encouragaing, I believe this proxy could be enriched. First of all, for sake of simplicity, I only took into account export that were representing more than 2% of export in terms of value. As a consequence, extrapoling the results of my model for the entire economy means that I make the hypothesis that the composition of major exports/imports (all those above 2%) are comparable to the composition of minor imports (all thoe below 2%). For instance, this means that it could be very important for a country to have a small but diverse export production. Even if each singular one would represent less than 2% of total export, these sectors could be substantial to address a negative shock on raw commodity prices. Additional analysis could fine tune the decomposition of the trade balance to correct the possible bias introduced only looking at major exports/imports. Still concerning my terms of trade index, I chose to average the value of total exports/imports over my period of interest. As a consequence, major changes in the composition of the trade balance of my sample may not be taken into account in my analysis. One of the example is Guinea Bissau. In my analysis, exports were exclusively relying on wood, which was labeled as "share of other commodity (agricultural only)" in table 1. But in fact, recent discoveries of marine oil fields should now be acocunted for in the first column: "share of commodity (price fixed in international markets)".

autoregression (PVAR) on diverse set of sub-samples over the 1980 – 2015 period. This approach does not impose an *a priori* constraint on the relationship between the 4 macroeconomic variables and thus allows to address the analysis of endogenous variables. After performing panel unit root test (Pesaran, 2007, detailed in appendix), I can conclude that the four macroeconomic variables are stationary and thus are suitable for the PVAR modelization.

The PVAR model

In the general case, I consider a k-variate homogeneous panel VAR model of order p with panel-specific fixed effects represented by the following system of linear equations[17]:

$$Y_{it} = Y_{i,t-1}A_1 + Y_{i,t-2}A_2 + \ldots + Y_{i,t-p+1}A_{p-1} + Y_{i,t-p}A_p + X_{it}B + u_i + e_{it} \tag{1}$$

$$i \in \{1, 2, \ldots, N\}, t \in \{1, 2, \ldots, T_i\}$$

With:
N the number of country i
T_i the length of the time series for country i.
Y_{it} is a $(1 \times k)$ vector of dependent variables with $k = 4$, namely $Y_{it} \begin{pmatrix} GDP_{it} \\ BCA_{it} \\ REER_{it} \\ FDI_{it} \end{pmatrix}$, with *GDP* and *BCA* being the first difference of respectively Gross Domestic Product growth and Current Account Balance as share of GDP. *REER* is the first difference of Real Effective Exchange Rate. FDI is the first difference of Foreign Direct Investment as share of GDP. X_{it} represents the exougenous variables that I alternatively add to the model: the proxy for terms of trade and its volatility, respectively named *tot* and *totsqr*. Here, the estimation method of ordinary least squares equation by equation is not relevant. I have on the right-hand side of the equations lagged dependent variables. Therefore, OLS method would lead to biased estimates even with a large N (Nickell, 1981) because the regressor Y_{it-1} is correlated with the fixed effect u_i. Even if the bias tends to *0* as T becomes larger, simulations by Judson and Owen (1999) find a significant bias for $T = 30$ which is about the size of my annual 1980-2015 dataset series.

Stationarity of the variables and unit root test

Before investing panel co-integration, I must first determine the existence of unit roots in the data series. I run the t-test for unit roots in heterogenous panels with cross-section dependence, proposed by Pesaran (2007). Parallel to Im, Pesaran and Shin (IPS, 2003) test, it is based on the mean of individual Dickey-Fuller[18] (DF) (or Augmented Dickey-Fuller -ADF) t-statistics of each unit in

[17] X_{it} is a vector $(1 \times l)$ vector of exogenous covariates. u_i is a $(1 \times k)$ vector of dependent variable-specific panel fixed-effects and e_{it} is a $(1 \times k)$ of idiosyncratic errors. The $(k \times k)$ matrices $A_1, A_2, \ldots, A_{p-1}, A_p$ and the $(l \times k)$ matrix B are parameters to be estimated. I assume that the innovations have the following characteristics: $E[e_{it}] = 0$, $E[e'_{it}e_{it}] = \Sigma$ and $E[e'_{it}e_{is}] = 0$ for all $t > s$.

[18] For the sake of simplicity, let's take the example of an *AR(1)* model which writes $y_t = \rho y_{t-1} + u_t$ where y_t is the variable of interest, and u_t the error term. A unit root occurs when the coefficient $\rho = 1$. The DF test is done over the residuals of the first difference regression, *ie* $\nabla y_t = (\rho - 1) y_{t-1} + u_t = \delta y_{t-1} + u_t$ where I test $\delta = 0$.

the panel. Null hypothesis assumes that all series are non-stationary[19]. Results are presented in appendix on tables 5 and 6. As expected, all variables are stationary except the raw REER_2010 which was on the basis 100 for the year 2010. This is why, now onward, REER will denote the first difference of REER_2010.

Application of the PVAR model

Following Arellano and Biver (1995), I instrument my model with available future observations (details are available in Appendix). Before running my PVAR, I systematically test for the optimal number of lags I should use relying on MAIC, MBIC and MQIB criteria. For all of my samples and subsamples, optimal number of lag is one. The model 1 features k=4, p=*1* writes either :

$$\begin{bmatrix} GDP_{it} \\ BCA_{it} \\ REER_{it} \\ FDI_{it} \end{bmatrix} = \begin{bmatrix} GDP^{*}_{it-1} \\ BCA^{*}_{it-1} \\ REER^{*}_{it-1} \\ FDI^{*}_{it-1} \end{bmatrix} A_1' + \begin{bmatrix} tot_{it-1} \\ totsqr_{it-1} \end{bmatrix} B' + \begin{bmatrix} e_{it}^{GDP*} \\ e_{it}^{BCA*} \\ e_{it}^{REER*} \\ e_{it}^{FDI*} \end{bmatrix}$$

After estimation my coefficients[20], I run test to insure the stability[21] of my PVAR. I also change the order of my variables and find no significant change in the interpretation of my results.

Results

Preliminary result: Assessing the strong dependency on raw commodities

First, I begin by assessing the high dependency of my sample on raw commodities with respect to their trade balance. Table 1 (presented below) and table 4 (in appendix) give quantitative support for this statement. Regarding the CFA zone, export value decomposition show that the entire zone relies almost exclusively on raw commodities belonging to the primary sector. Even more interestingly, when matching these raw export with COMTRADE database, I find out that most of these exports are priced in international markets, almost always in dollars. This means that

[19]To eliminate the cross dependence, the standard DF (or ADF) regressions are augmented with the cross section averages of lagged levels and first-differences of the individual series (CADF statistics). Considered is also a truncated version of the CADF statistics which has finite first and second order moments. It allows to avoid size distortions, especially in the case of models with residual serial correlations and linear trends (Pesaran, 2007).

[20]Following Abrigo and Love (2015), let's suppose the common set of $L \geq kp + l$ instruments is given the row vector Z_{it} where $X_{it} \in Z_{it}$. Let's suppose I stack observations over panels and then over time. The GMM estimator is given by:

$$A = \left(\overline{Y^*}' Z \hat{W} Z' \overline{Y^*}\right)^{-1} \left(\overline{Y^*}' Z \hat{W} Z' Y^*\right)$$

where $\hat{W}$ is a *(LxL)* weighting matrix assumed to be non-singular, symmetric and positive semi-define. Assuming that $E[Z'e] = 0$ and rank $E\left[\overline{Y^*}' Z\right] = kp + l$, the GMM estimator is consistent. The weighting matrix $\hat{W}$ may be selected to maximize efficiency (Hansen, 1982).

[21]I check if my VAR is model is stable by calculating the modulus of each eigenvalue of the estimated model (cf figure 6). As shown by Lutkepohl (2005) and Hamilton (1994), a VAR is stable if all moduli of the companion matrix are strictly less than one. Because the VAR is stable, it is then invertible and has an infinite-order vector moving-average representation. This is the basis for the later computation of impulse-response functions and error variance decomposition.

Country	Share of Commodity (price fixed on int'l markets)	Share of other Commodity (agricultural only)	Other exports
Benin	91%	2%	6%
Burkina Faso	90%	10%	0%
Cameroon	97%	3%	0%
Congo	85%	0%	15%
Central Africa Rep	97%	0%	3%
Ivory Coast	93%	4%	4%
Gabon	100%	0%	0%
Guinea Bissau	0%	100%	0%
Mali	97%	3%	0%
Niger	71%	21%	7%
Togo	59%	0%	41%
Senegal	45%	25%	30%

Table 1: Share of the Commodity in Total of Main Exports for CFA members

Source: Authors calculations from COMTRADE dataset, average 1995-2015

Note, share are expressed as share in value

Here, I only take into account exports that represents at least 2 percent of the total exports. This is why 0 percent could in fact neglect a sum of several < 2 percent observations.

the countries of the area do not have much room, independently of the nominal exchange rate, to negotiate the price at which they will sell their commodities. As a matter of fact, 7 out of 12 countries of the CFA zone[22] rely on 90% or more on raw commodities priced on international markets for their export. Another way to unwrap the export of the CFA members is to say that only 2 countries, namely Togo and Senegal exports more than 20% of non primary sector commodities: respectively 41%[23] and 30%[24]. Concerning the comparable SSA countries not belonging to the CFA zone, export decomposition show a strong dependence on raw commodities. More specifically, 6 countries out of 9 rely on 90% or more on raw commodities priced on international markets. From this subsample, only Gambia export more than 10% of non primary sector commodities. This assessment of high dependence on raw commodities is the core element of this paper. The idea is to use the high dependency of both the CFA zone and of the control group (comparable SSA but non-CFA countries) but the different constraint on the monetary policy of the two samples. This way my analysis can focus on the following question: to what extend does this constraint on monetary policy affect mechanisms between growth, current account and real exchange rate in CFA countries.

[22]UNCTAD COMTRADE data was not available for Chad and Equatorial Guinea

[23]Togo "other exports" include notably "cement", "articles for the conveyance or packing of goods" and "beauty and skin care products"

[24]Senegalk "other exports" include notably "chemicals" and "cement"

On the short run, the peg makes it harder for CFA countries to address shocks on terms of trade

When looking at the result of the PVAR model on table 2, I first observe that the proxy for terms of trade has a strong impact on BCA (equation 2). This impact is within the 1% significance threshold for both the CFA and the non-CFA sub-samples. However, I observe a much larger coefficient for CFA than for non-CFA countries. Still focusing on the BCA, I show a very different impact of terms of trade in the two subsamples. BCA of the CFA zone is negatively impacted by a higher volatility of the terms of trade index (at 1% significance level) whereas the impact is sightly positive, yet at a much lower significance level of 10% for the non-CFA subsample. This highlights the difficulties of the CFA countries that cannot rely on the adjustment of nominal exchange rate to address the issue of volatility of the prices of their raw exports. The difficulty of the CFA zone to address volatility of terms of trade is even more substantial when looking at the impact on GDP. Even if I did not find evidence for an impact of terms of trade on GDP, I show that volatility of the terms of trade index negatively impacts GDP only in the CFA (5% significance level), but has no significant impact in the comparable sample. These results are aligned with extensive literature that show that flexible exchange rate are the most efficient way to address temporary terms of trade shocks on the short term (Easterly 1993; Mendoza 1997; Rodrick 1999; Broda 2004; Sissoko and Dibooglu 2006; Funke 2008). Flexible exchange rate can be considered as a shock absorber. To this extent, the pegged CFA zone that relies heavily on raw commodities, suffers more than non-CFA following a shock on terms of trade. This shows that autonomous monetary policy acts like a countercyclical tool to address volatility of terms of trade shocks and mitigate its impact on national output in SSA region.

Beyond the ability to address shocks on terms of trade, let's explore how the peg affects the ability to address an unexpected shocks on growth. Let's recall from economic theory (*cf* theoretical issues above) that a surge in growth induces an appreciation of the exchange rate expressed in real terms. Autonomous central banks have the means to counteract this effect by acting on the nominal exchange rate. In the case of CFA members, on table 2, I can observe a positive and significant impact of a rise of GDP on REER. This result, also observable on figures 1 and 2, highlights the mechanical real price adjustment that occurs following an output overheating when there is no autonomous monetary policy. In the case of the CFA zone, I reject the existence of a long-term Balassa-Samuelson effect to explain this positive correlation[25]. This result seems to be explained[26] by the fact that contrarily to CFA members, nominal effective exchange rate in these floating regimes can adjust faster than real terms (*ie* prices) following an unexpected output growth. This result is aligned with the recent paper of Couharde *et al.* (2013). This lack of control on the real exchange rate over the short term creates an additional difficulty for the CFA zone. Without an autonomous monetary policy, an unexpected shock of REER has a negative effect on GDP. This is observed only in the CFA zone and not in the comparative sample. As table 2 displays, strong negative correlation of REER affects the GDP equation for the CFA zone (1% confidence interval). The impact is still negative for non-CFA sample however at a much smaller scale and much smaller significance level (at 10% level), and becomes non significant

[25] I replaced my growth variable by a proxy for productivity (*ie* real output growth in PPP per capita) and found no evidence for a relationship between REER and productivity.

[26] An alternative explanation, independent from the Balassa-Samuelson hypothesis is proposed by Aslam *et al.* (2016). They explain that a surge of GDP does not necessarily lead to a real appreciation. In Chile, following a boom in commodity price and then in national output, there was no real appreciation as expected because the commodity sector was owned by foreigners.

when controlling for terms of trade. Overall, the results of the PVAR model show that the peg introduces more struggle from CFA countries to address unexpected shocks. These countries rely on raw commodities which prices are determined exogenously on international markets, labeled in dollars and subject to volatility over the period of interest. As a consequence, CFA countries are more vulnerable than non-CFA countries to address shocks.

No evidence for a loss of competitiveness through export prices after one year

When considering the short-term impact of REER on the BCA, the CFA zone stands out once again. As table 2 as well as impulse response functions[27] (IRF) on figures 1 and 2 show, an appreciation of REER has a significant and positive impact on the BCA for CFA members (1 percent confidence interval[28]). This is not the case for my subset of non-CFA countries: an appreciation of REER has a negative and strong significant impact on BCA. This argues for a rejection of the Marshall-Lerner condition[29] in the CFA zone after a one year period. Even if advancing a formal proof of this hypothesis requires an estimation of price-elasticities; hence lays beyond the scope of this paper[30], several arguments back up this theory. As a recall from the economic theory, if the price effect overtakes the volume effect, hence a appreciation of the REER leads to a positive effect on the trade balance. When looking at the CFA zone, several elements contribute to the counter intuitive result of a positive impact of REER on BCA. Their members rely heavily on imports of capital goods and equipment with a significant part (about half, *cf* Appendix 4, Figure 3) of these goods which are not labeled neither in CFA franc nor in euro. As a consequence, these imports positively benefit from an appreciation of the currency. Second, regarding the volume effect, one can expect it to be extremely limited because CFA members export almost exclusively raw materials. For such goods, price competitiveness is negligible because their value is internationally set on commodity markets. Moreover, a recent study from Farooq (2009) with data from a similar period of interest (1990-2007) show that a weaker dollar (often associated with a stronger euro) leads to higher commodity prices. We suspect this effect to drive the positive impact of an appreciation of REER on BCA in the CFA zone. Overall, the time frame is important to keep in mind. Krugman and Obstfeld (2000) showed that in most cases, short term effect dominates on the short run but volume effect dominates in the longer run. Interestingly, the comparative sample gives information about the specificity of the CFA zone. Whereas after one year, the volume effect seems to overrun the price effect in non-CFA countries, it is not the case within the zone. The hypothesis I defend here is the greater dependency of the CFA zone regarding imports both for its domestic production (agricultural machinery, capital-intensive goods) as well as the needs for the upper-income class of the society (Chassem 2011). This strong dependence reduce the price elasticity of the trade balance[31] and thus hampers the volume effect. Hence after one year, price effect is still overrunning a potential volume effect (if any) in the CFA zone.

[27] Confidence bands are estimated using Gaussian approximation based on Monte Carlo draws from the estimated panel VAR model. I usually set the number of Monte Carlo draws to be 100 because this is the most common in the

Table 2: PVAR estimates

Variable	**CFA**	**CFA**	**ECCAS and WAMZ**	**ECCAS and WAMZ**
	(Std. Err.)	(Std. Err.)	(Std. Err.)	(Std. Err.)
Equation 1 : GDP				
L.GDP	0.263**	-0.0384	0.375**	0.391**
	(0.048)	(0.0729)	(0.131)	(0.134)
L.BCA	0.053	0.0251	0.128	0.135
	(0.126)	(0.0578)	(0.087)	(0.097)
L.REER	-68.261**	-14.338**	-2.638†	-4.011
	(18.336)	(3.617)	(2.824)	(1.539)
L.FDI	0.781**	0.198*	0.309**	0.340**
	(0.105)	(0.783)	(0.078)	(0.986)
tot	-	-0.00305	-	-0.0333
		(0.0182)		(0.0350)
tot_sqr	-	-0.00178*	-	-0.0023
		(0.00073)		(0.00150)
Equation 2 : BCA				
L.GDP	-0.206**	-0.0649	0.0040	0.0413
	(0.047)	(0.0533)	(0.0640)	(0.0585)
L.BCA	0.500**	0.582**	0.816**	0.814**
	(0.046)	(0.0638)	(0.099)	(0.0867)
L.REER	5.178*	16.317**	-18.684**	-12.775**
	(2.564)	(2.847)	(3.194)	(2.966)
L.FDI	-0.036	0.0378	0.248**	0.210**
	(0.052)	(0.101)	(0.854)	(0.758)
tot	-	0.202**	-	0.0680**
		(0.0280)		(0.0257)
tot_sqr	-	-0.0031**	-	0.0019†
		(0.0011)		(0.0012)
Equation 3 : REER				
L.GDP	0.00066**	0.00214†	-0.0001	-0.00006
	(0.00019)	(0.0013)	(0.0013)	(0.0013)
L.BCA	0.00120*	0.00067	-0.0009	-0.0021
	(0.00047)	(0.00096)	(0.0014)	(0.0015)
L.REER	-0.00679	0.151†	0.321**	0.263**
	(0.0614)	(0.0805)	(0.0557)	(0.0613)
L.FDI	0.00114**	-0.00353*	-0.0019	-0.0014
	(0.00043)	(0.00144)	(0.0017)	(0.0019)
tot	-	-0.00011	-	0.00031
		(0.00031)		(0.00059)
tot_sqr	-	0.0000	-	-0.0000
		(0.000)		(0.000)
Equation 4 : FDI				
L.GDP	0.290**	0.0093	-0.037	-0.0534
	(0.0418)	(0.0253)	(0.0360)	(0.0388)
L.BCA	0.0538	0.0618†	-0.121†	-0.1123†
	(0.0509)	(0.0348)	(0.0675)	(0.0626)
L.REER	12.263*	3.756*	7.479**	6.154*
	(5.331)	(1.631)	(0.261)	(2.415)
L.FDI	0.553**	0.774**	0.457**	0.410**
	(0.0797)	(0.0636)	(0.0970)	(0.983)
tot	-	-0.0306*	-	-0.0121
		(0.0143)		(0.0159)
tot_sqr	-	0.0009	-	-0.0004
		(0.00069)		(0.0011)

Legend - Significance Levels † : 10% ∗ : 5% ∗∗ : 1%

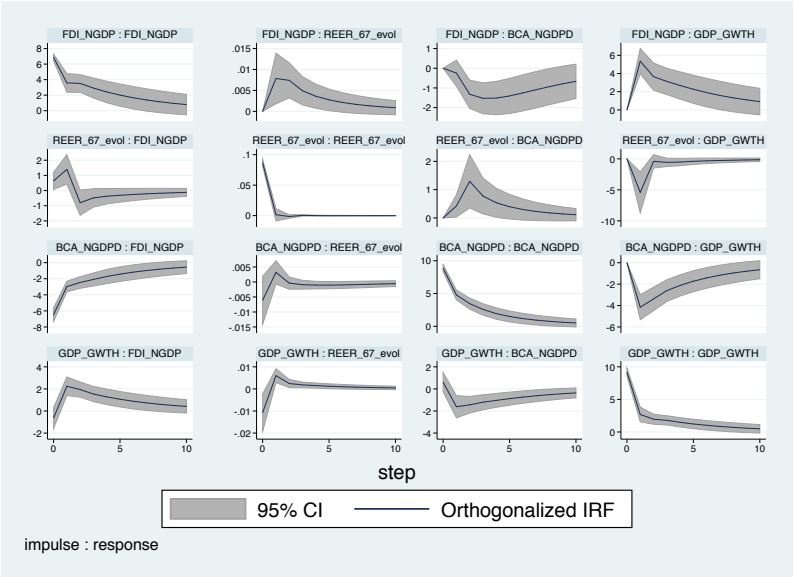


Figure 1: IRF PVAR CFA sample

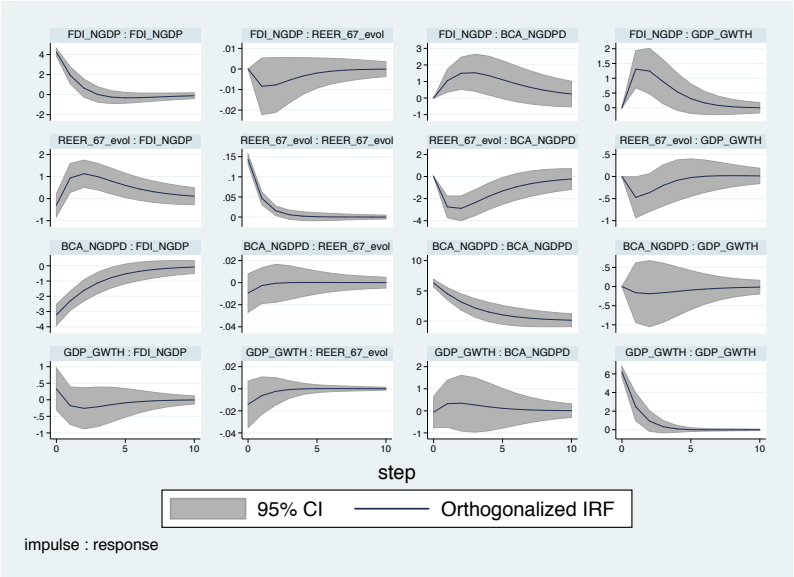


Figure 2: IRF PVAR non-CFA SSA sample

Overall, a low attractiveness of the productive sector for investors in CFA countries

Let's first underline an expected but important result. In all of my PVAR variations, FDI has a strong significant (1% confidence interval) and positive impact on GDP on a one-year interval (*cf* IRF function on figures 1 and 2). As FDI has been extensively described by the literature[32] as an important driver for growth, let's explore how this forth endogenous variable of the PVAR interact with the other ones. The most important result is probably the suspicion of an crowding-out effect of public expense in the CFA zone. On table 2, a positive shock on the terms of trade index is associated with a negative impact on FDI only in CFA countries. Similarly, but with a lower significance, positive shock on BCA leads to a negative impact on FDI only in the pegged area. This result is aligned with Funke, Granziera and Imam (2008) who state that positive shocks on terms of trade are assumed to be permanent whereas negative shocks are assumed to be transitory. This perception biais leads to higher public spending instead of saving during expansion period. In turn, this additional spending can discourage private investment following a positive shock on the terms of trade proxy.

Conclusion

The theoretical question that triggered my analysis was the following : are macroeconomic interactions different in the CFA zone compared to other SSA countries. I started by highlighting two specificities of this monetary union: the peg and the high dependence on raw commodities. This justifies the focus on the interactions between four key endogenous macroeconomic variables (GDP, BCA, REER and FDI) in the CFA zone. An extensive literature has focused on the impact of the peg, both in a general set up and more specifically in the CFA zone. These studies mostly tend to focus on the long term impact of the peg. A majority of authors conclude on the lack of business cycles synchronizations and the persistance of exchange rate misalignements that could hamper growth. From a long term perspective, if the CFA zone is not considered as optimal, it is nonetheless considered as sustainable (Couharde *et al.* 2013). As a matter of fact, the stability introduced by the peg is often given as a positive argument on the long run to attract FDI, insure low inflation and eventually foster growth (Sachs and Warner 1997; Rodrick 1998).
However, to the best of my knowledge, I have not found any studies focusing on the short to middle-term impact of the peg on macroeconomic interactions including a proxy for terms of trade. This proxy allows to take into account one of the most important characteristic of the sample: the high dependance on raw commodities. A PVAR model allows to study these macroeconomic interactions. Two different comparable subsets of CFA and non-CFA SSA countries has been helpful to assess the impact of the peg. My results are three-fold. First, I show that the peg makes it more difficult for countries to address shocks, especially on terms of trade. A flexible exchange rate is a shock

related literature.

[28] when controlling for the proxy for terms of trade, and 5% confidence interval without the control

[29] The Marshall-Lerner condition states that BCA is a decreasing function of REER if and only if the sum of price elasticities of imports and exports as absolute value is greater than 1.

[30] Note that a working paper from Chassem (2011) reject empirically the Marshall Lerner condition for almost every CFA members.

[31] in other words, there does not really exist a competition on the domestic markets between imports and locally produced goods (Dufrénot and Sugimotor 2013)

[32] notably by a recent PVAR approach by Fauzel, Seethanah and Sannassee (2014)

absorber. The high dependency on raw commodities of these countries exacerbate this impact. Terms of trade shocks are much more impactful in the CFA zone compared to the non-CFA SSA subset. The peg seems to introduce an unability to address terms of trade volatily which negatively impacts growth only for CFA countries. The second major result is that the peg does not introduce a loss of competitiveness for CFA exports. Indeed, the PVAR model demonstrates that a real appreciation has a significant positive impact on BCA for CFA countries and a significant negative impact for non-CFA countries. This suggests that on a one-year intervall for CFA countries, the volume effect does not overrun the price effect. The strong dependence of the CFA zone on imports can explain the very low price elasticity of the trade balance. The third result relates to investor attractiveness. I find a strong positive relation between FDI and growth for each of my subsamples. Nonetheless, trade balance expansions in the CFA zone (especially when associated with a positive shock of terms of trade) negatively impacts FDI. This could be an evidence for a crowding-out effect of public expenses in the CFA zone during expansions.

Appendix 1. African Economic and Monetary Communities of Interest

	WAMZ	CFA zone		ECCAS
		WAEMU	CEMAC	
Benin		X		
Burkina Faso		X		
Ivory Coast		X		
Guinea Bissau		X		
Mali		X		
Niger		X		
Senegal		X		
Togo		X		
Cameroon			X	X
Central African Republic			X	X
Chad			X	X
Rep. of Congo			X	X
Equatorial Guinea			X	X
Gabon			X	X
Angola				X
Burundi				X
Dem. Rep. of the Congo				X
Rwanda				X
Sao Tome et Principe				X
Gambia	X			
Ghana	X			
Guinea	X			
Liberia	X			
Nigeria	X			
Sierra Leone	X			

Figure 3: Share of CFA Imports coming from EU

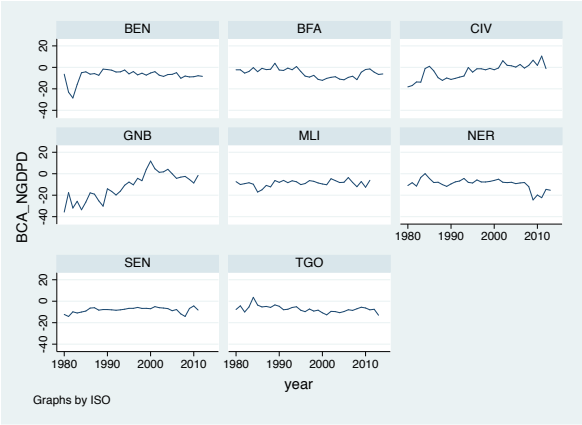
Appendix 2. Share of CFA trade exchange with the EU

Appendix 3. Dependence on Raw Commodity - non-CFA SSA countries

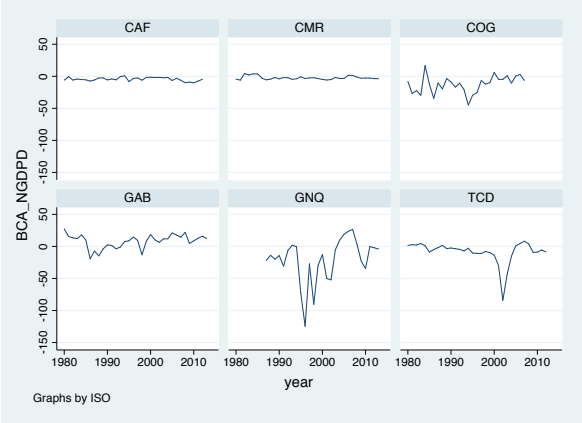
Country	Share of Commodity (price fixed on int'l markets)	Share of other Commodity (agricultural only)	Other exports
ECCAS (non-CFA)			
Angola	98%	2%	0%
Burundi	100%	0%	0%
Sao Tome et P.	100%	0%	0%
Rwanda	81%	17%	3%
WAMZ			
Gambia	0%	37%	63%
Ghana	100%	0%	0%
Guinea	85%	10%	6%
Nigeria	100%	0%	0%
Sierra Leone	97%	3%	0%

Table 4: Share of the Commodity in Total of Main Exports for WAMZ & CEMAC (non-CFA) members
Source: Authors calculations from COMTRADE dataset, average 1995-2015
Here, I only take into account exports that represents at least 2 percent of the total exports. This is why 0 percent could in fact neglect a sum of several < 2 percent observations.

Appendix 4. Trade Balance Analysis



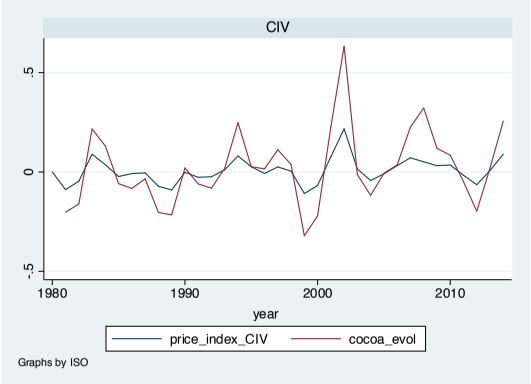
(a) West CFA



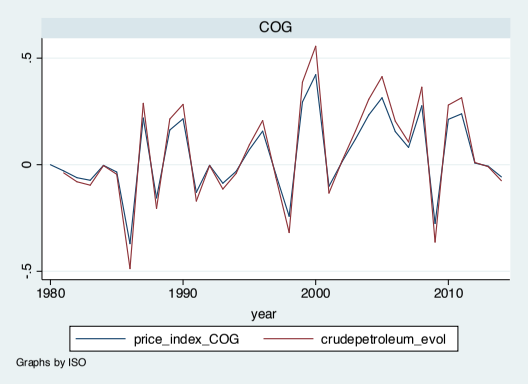
(b) Central CFA

Figure 4: Trade Balance of CFA members (1980 - 2015)
Source: UN COMTRADE

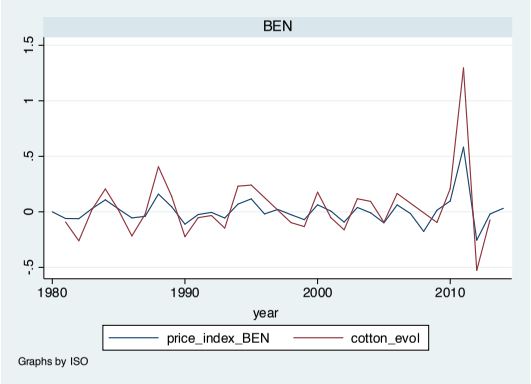
Ivory Coast



Congo



Benin



Mali

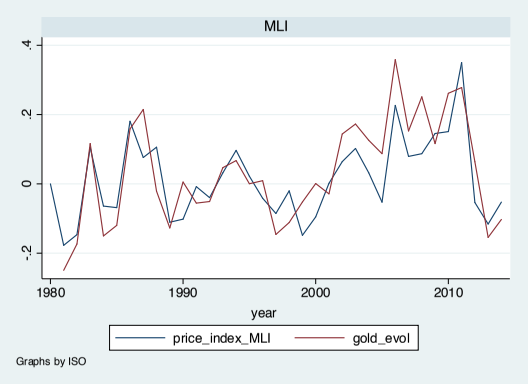


Figure 5: Country ToT index and #1 export commodity

Appendix 5. Instrumenting the PVAR model

Different instruments have been used to address the inconsistency of the OLS estimator. First, Anderson and Hsiao (1981) have proposed to estimate an AR(1) model transform as first-difference model to get rid of the fixed effects such as:

$$y_{it} - y_{i,t-1} = A\left(y_{i,t-1} - y_{i,t-2}\right) + \left(x_{it} - x_{i,t-1}\right)'\beta + \left(u_{it} - u_{i,t-1}\right) \tag{2}$$

By using $y_{i,t-2}$ as instrument for $(y_{i,t-1} - y_{i,t-2})$ which is a good instrument because not correlated with $(e_{it} - e_{i,t-1})$ assuming that the errors e_{it} are serially uncorrelated. but correlated to $(y_{i,t-1} - y_{i,t-2})$. Thus, for an *AR(1)* it requires $T \geq 3$ from a theoretical point of view. Anderson and Hsiao (1981) showed also that the Instrument Variable (IV) estimator is more efficient when using $\triangle y_{i,t-2}$ rather than $y_{i,t-2}$. But it requires another observation such that $T \geq 4$. Further papers showed that a more efficient estimation is possible by using additional lags of the dependent variables as instruments. This helps to minimize data loss. This is important in my case because my time series is limited to around 30 observation. As a remedy to the loss of observations due to the use of a larger set of lags as instruments I decide to follow Holtz-Eastin, Newey and Rosen (1988) and I substitute missing values with zeros. Note that observations with no valid instruments are excluded. This transformation is based on the standard assumption that the instrument list is uncorrelated with the errors[33].

Alternatively, Arellano and Biver (1995) showed it was more efficient to take into account all available future observations rather than a set of passed observations. By this means, all of past lags can be used as instruments. Let's apply it to the model 1. It writes in a more compact form as:

$$Y_{it}^{*} = \overline{Y_{it}^{*}}A + e_{it}^{*}$$

With[34],

$$Y_{it}^{*} = \begin{bmatrix} y_{it}^{1*} & y_{it}^{2*} & \dots & y_{it}^{k-1*} & y_{it}^{k*} \end{bmatrix}$$

$$\overline{Y_{it}^{*}} = \begin{bmatrix} Y_{i,t-1}^{*} & Y_{i,t-2}^{*} & \dots & Y_{i,t-p+1}^{*} & Y_{i,t-p}^{*} & X_{it}^{*} \end{bmatrix}$$

$$e_{it}^{*} = \begin{bmatrix} e_{it}^{1*} & e_{it}^{2*} & \dots & e_{it}^{k-1*} & e_{it}^{k*} \end{bmatrix}$$

$$A' = \begin{bmatrix} A_1^{'} & A_2^{'} & \dots & A_{p-1}^{'} & A_p^{'} & B' \end{bmatrix}$$

[33] For instance, on my SSA data subset, this method allows to improve the average T available from 27.4 to 30.4

[34] Where the star denotes the transformation from the original variable. If I denote the original variable as v_{it}, then the first difference transformation means that $v_{it}^{*} = v_{it} - v_{it-1}$, whereas the forward orthogonal deviation writes $v_{it}^{*} = (v_{it} - \overline{v_{it}})\sqrt{\frac{T_{it}}{(T_{it}+1)}}$ where T_{it} is the number of future observations for panel i at time t, and $\overline{m_{it}}$ its average.

Appendix 6. Panel Unit Root Test in presence of cross section dependance (MW & Pesaran tests)

Below, I run the multipurt command (panel unit root tests for multiple variables and lags). Two tests are run one after the other : The Maddala and Wu (1999) as well as Pesaran[35] (2007). Each test is run with lag=0 and lag=1, and also with and without trend. The goal here is to ensure that the 4 macroeconomic variables are stationary. I also include a time trend in the linear equation. Note that I perform this test systematically when my subset of observations changes in order to ensure my PVAR includes exclusively stationary variables. Below I chose to report only results of the Pesaran test[36]. I conclude here that all my variables (GDP, BCA and FDI) are stationary at the excpetion of REER. This is why I construct both its first difference and the first difference of its log. Both of these transformation are now stationary. For this paper, the first difference of variable of REER will be prefered.

Null for CIPS tests: series is I(1). CIPS test assumes cross-section dependence is in form of a single unobserved common factor.

Table 5: PURT test (whole sample)

Variable	**Lags**	**With constant**		**With constant and trend**	
		Stat-test	**P-value**	**Stat-test**	**P-value**
GDP	0	-29.263**	0.000	-26.774**	0.000
GDP	1	-19.604**	0.000	-17.015**	0.000
BCA	0	-11.842**	0.000	-10.500**	0.000
BCA	1	-8.702**	0.000	-8.998**	0.000
FDI	0	-22.599**	0.000	-18.494**	0.000
FDI	1	-12.127**	0.000	-8.842**	0.000
REER_2010	0	2.260	0.988	7.743	1.000
REER_2010	1	-1.162	0.123	3.373	1.000
REERevol	0	-33.628**	0.000	-30.574**	0.000
REERevol	1	-20.600**	0.000	-17.935**	0.000
lnREERevol	0	-38.557**	0.000	-34.458**	0.000
lnREERevol	1	-25.900**	0.000	-21.744**	0.000

[35]-multipurt- uses Scott Merryman's -xtfisher- and Piotr Lewandowski's -pescadf-. pescadf runs the t-test for unit roots in heterogenous panels with cross-section dependence, proposed by Pesaran (2007). Parallel to Im, Pesaran and Shin (IPS, 2003) test, it is based on the mean of individual DF (or ADF) t-statistics of each unit in the panel. Null hypothesis assumes that all series are non-stationary. To eliminate the cross dependence, the standard DF (or ADF) regressions are augmented with the cross section averages of lagged levels and first-differences of the individual series (CADF statistics). Considered is also a truncated version of the CADF statistics which has finite first and second order moments. It allows to avoid size distortions, especially in the case of models with residual serial correlations and linear trends (Pesaran, 2007).

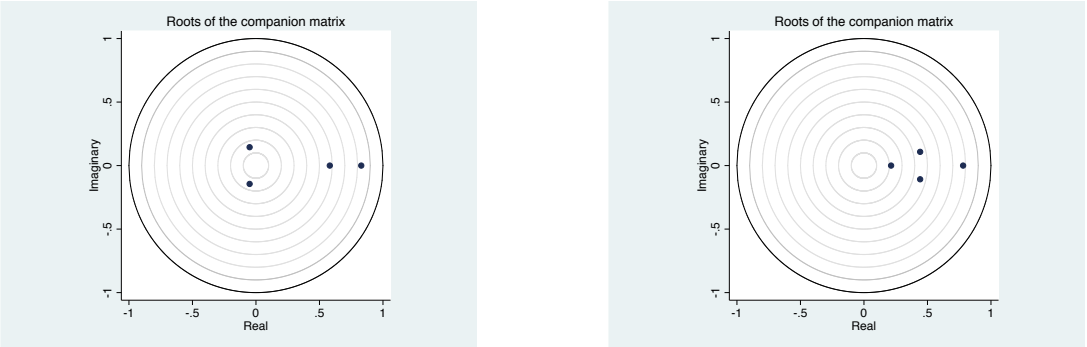
[36]MW tests were systematically leading to the same conclusions

Table 6: PURT test (CFA subsample)

Variable	Lags	With constant		With constant and trend	
		Stat-test	P-value	Stat-test	P-value
GDP	0	-13.274**	0.000	-12.547**	0.000
GDP	1	-9.324**	0.000	-9.091**	0.000
BCA	0	-5.894**	0.000	-4.415**	0.000
BCA	1	-4.894**	0.000	-4.199**	0.000
FDI	0	-5.188**	0.000	-6.292**	0.000
FDI	1	-2.213**	0.013	-2.783**	0.003
REER_2010	0	-3.299**	0.000	-3.089**	0.001
REER_2010	1	-4.956**	0.001	-6.221**	0.000
REERevol	0	-13.729**	0.000	-13.123**	0.000
REERevol	1	-11.477**	0.000	-11.263**	0.000
lnREERevol	0	-13.582**	0.000	-12.860**	0.000
lnREERevol	1	-11.516**	0.000	-11.281**	0.000

Appendix 8. Stability condition check on the PVAR model

Following Abrigo and Love (2015), I run the post-estimation command *pvarstable* to check the stability condition of panel VAR estimates by calculating the modulus of each eigenvalue of the estimated model. Lutkepohl (2005) and Hamilton (1994) both show that a VAR model is stable if all moduli of the companion matrix are strictly less than one. Stability implies that the panel VAR is invertible and has an infinite-order vector moving-average representation, providing known interpretation to estimated impulse-response functions and forecast-error variance decompositions. Below is an example of the graph of these eigenvalues for the lower middle income countries subsample but I in fact run this post-estimation test systematically to ensure that the PVAR has the right properties.



(a) CFA subset

(b) SSA non-CFA subset

Figure 6: Stability Condition Test for the PVAR

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