FOR AGENDA

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July 25, 2008

To: Members of the Executive Board

From: The Secretary

Subject: **Central African Economic and Monetary Community—Selected Issues**

This paper provides background information to the staff report on common policies of member countries of the Central African Economic and Monetary Community (CEMAC) (SM/08/253, 7/25/08), which is tentatively scheduled for discussion on **Friday, August 8, 2008.** At the time of circulation of this paper to the Board, the Secretary's Department has not received a communication from the authorities of the CEMAC countries indicating whether or not they consent to the Fund's publication of this paper; such communications may be received after the authorities have had an opportunity to read the paper.

Questions may be referred to Mr. Wakeman-Linn (ext. 34145), Ms. Deléchat (ext. 39681), and Mr. Portillo (ext. 39329) in AFR.

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INTERNATIONAL MONETARY FUND

CENTRAL AFRICAN ECONOMIC AND MONETARY COMMUNITY

Selected Issues

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Approved by the African Department

July 25, 2008

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I. A Structural Analysis of the Determinants of Inflation in the CEMAC Region[1]

A. Introduction

1. One of the main policy objectives for the BEAC is to ensure price stability. To fulfill its role, the BEAC must be able to identify the forces driving inflation. In particular, it must be able to distinguish between supply, demand, domestic and external shocks. It must also understand how these shocks propagate through the economy, and be able to forecast prices (and other variables) in the short and medium-term conditional on the types of shocks relevant today.

2. This difficult task helps inform the BEAC monetary policy decisions, i.e., whether to adjust its short term interest rates and or reserve requirements. In addition, it can help pin down the role of fiscal policy in price stability and therefore reinforce the need for coordination between fiscal and monetary policy. This can be particularly useful when serving in advisory capacity to national governments.

3. This chapter aims to identify the main structural determinants of inflation in the CEMAC region, with a focus on the region as a whole, rather than on individual countries. We are particularly interested in the impact of the fiscal stance, as the availability of oil revenues allows for (potentially) more expansionary fiscal policy than would be the case otherwise; and the fluctuation of oil prices can lead to substantial fluctuations in the fiscal impulse.

4. We use two methods to identify the sources of inflation. First, we use a semi-structural VAR analysis as a starting point. Second, we develop and estimate a dynamic stochastic general equilibrium model for the region. One of the advantages of the second approach is that it provides a coherent framework to analyze the channels through which fiscal shocks propagate through the economy. The model also allows the running of forward looking monetary policy experiments, which can be of great help to monetary authorities.

5. We find that fiscal shocks—measured as exogenous changes in the non-oil fiscal stance—have been an important source of inflation in the region, accounting for about 20 percent of inflation volatility over the last ten years. As the model indicates, this was due in part to the passive nature of monetary policy during the period.

6. The paper is organized as follows: Section B. presents some visual evidence regarding the link between fiscal policy and other variables. Section C presents results from a

[1] Prepared by Rafael Portillo.

VAR-based approach. Section D presents the DSGE model, while section E presents the estimation results for that model. Finally, section F concludes.

B. Structural Determinants of Inflation in the CEMAC Region: The Usual Suspects

7. The structural analysis of inflation requires the identification of the main shocks that may affect the price level, as well as the channels through which these shocks operate. Here is a list of potential candidates:

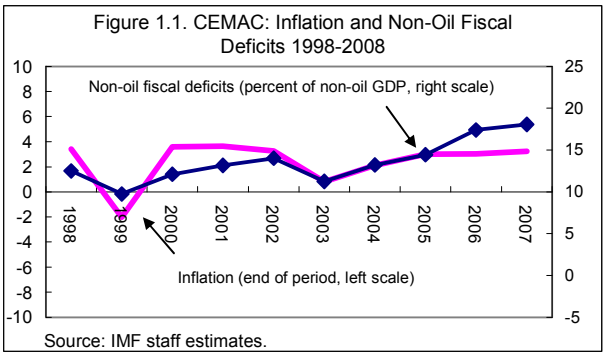
- fiscal policy;
- monetary policy;
- imported inflation;
- domestic supply shocks;
- and changes in regulated prices.

8. While they are likely to be important in accounting for price fluctuations at any given quarter, this paper does not address the issue of regulated prices. Each of the remaining shocks is discussed below.[2]

Fiscal policy

9. In the CEMAC region, where oil is the largest export sector and a large fraction of oil revenue accrues to governments, oil-driven fiscal policy may be an important source of fluctuations in aggregate demand. This is especially the case if government spending is concentrated primarily on local goods and services. Identifying the fiscal impulse in oil rich economies requires that oil revenue be excluded from the measure of the fiscal stance. The resulting non-oil fiscal balance for the entire region, defined here as the sum of non-oil deficits over the sum of non-oil GDP for each country is presented in Figure 1.1 along with end of period inflation for the entire region, over the period 1998-2007.[3]

Figure 1.1. CEMAC: Inflation and Non-Oil Fiscal Deficits 1998-2008



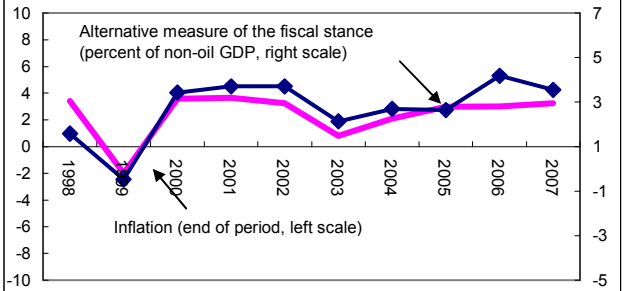
Source: IMF staff estimates.

[2] For an alternative analysis of inflation dynamics, see Delechat et al (2008).

[3] Inflation numbers for the CEMAC region are constructed as a PPP weighted-geometric average of member countries' inflation.

10. There is a clear link between these two variables. However, there is the risk that the positive relationship may be driven by a third variable. For example, if the real depreciation of the franc CFA is positively correlated with inflation (which is the case, as will be shown later), then the comovement in Figure 1.1 could be driven by public expenditure items that are sensitive to exchange rate fluctuations, such as interest payments on external debt, or expenditure items concentrated on imported goods, such as capital expenditures. Since these items should not lead to an increase in demand pressures, the measure of the fiscal stance is further refined by removing these items.[4] The fiscal stance is therefore defined as the non-oil fiscal deficit net of interest payments on foreign debt and capital expenditures. Figure 1.2 shows the time series for this alternative measure:

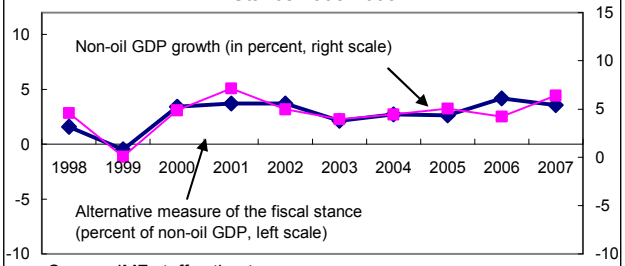
Figure 1.2. CEMAC: Inflation and the Fiscal Stance 1998-2008



Source: IMF staff estimates.

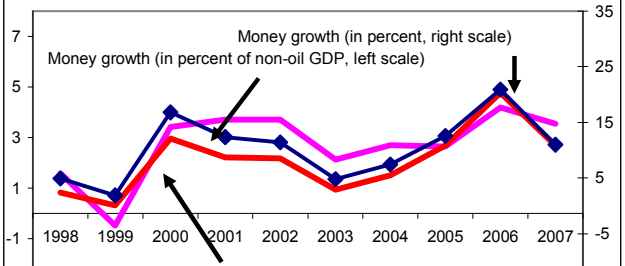
11. The comovement between these the fiscal stance and inflation is now higher than before: the correlation is 0.83. In order to understand where this comovement is coming from, we explore the link between the fiscal stance and other variables. First, the fiscal stance is also correlated with non-oil GDP growth (Figure 1.3) which suggests that the fiscal stance has a considerable impact on aggregate demand.

Figure 1.3. CEMAC: Non-Oil Growth and the Fiscal Stance 1998-2008



Source: IMF staff estimates.

Figure 1.4. CEMAC: Average Money Growth and the Fiscal Stance 1998-2008



Source: IMF staff estimates.

12. In addition, the region's fiscal stance is also closely correlated with average money growth.[5] Figure 1.4 displays the comovement between the

[4] There is a break in the series in 2002. This may reflect a change in the classification of spending or revenue items. However, the comovement between the series pre-break with the variables of interest (money growth, inflation, non-oil growth) is as strong—at least visually—as it is post-break, albeit a different level. For the purpose of the analysis, we correct the pre-break series with the difference in levels pre- and post-2002.

[5] We define average money growth as the average of the end of period money growth over four quarters.

fiscal stance and money growth, measured both in terms of money and in terms of non-oil GDP: Two features of the relationship are worth emphasizing. First, there is a strong comovement between money growth and the fiscal stance: the correlation is 0.83. Second, the magnitude of the changes in broad money, measured as a fraction of non-oil GDP, is similar to the magnitude of the fiscal stance. This relation does not operate through the standard concept of fiscal dominance, which would interpret such relations as driven by direct monetary financing of the deficit. Indeed, the comovement between the fiscal stance and growth in net credit to the government during this period is -0.37. Instead, this comovement is the result of higher government spending out of oil revenue, which leads to a monetary injection when government spending focuses on local goods and monetary policy is passive under a fixed exchange rate regime. This mechanism will be explored further in section D.

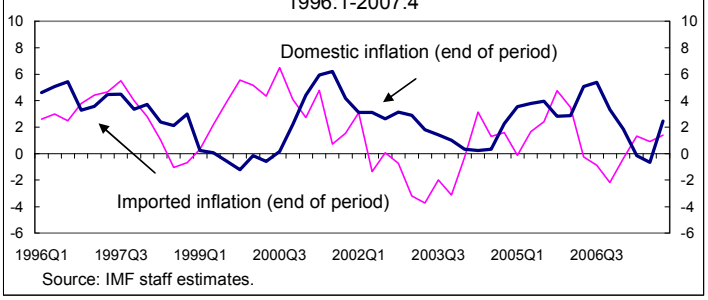
Monetary policy

13. In principle, under a fixed exchange rate regime (tied to the euro in this case), monetary policy is not autonomous. Capital mobility implies that the domestic short term interest rate is determined by the euro rate as well the risk premium associated with that country or group of countries. Moreover, the stock of money is determined by the liquidity needs of economic agents and the inflows of foreign capital to finance purchases of local assets and goods. In the CEMAC region, there is de-facto limited mobility of capital, which provides some degree of independence for monetary policy and implies that the short term interest rate may deviate from the euro rate. In practice however, monetary policy was mostly passive during this period. The implication is that monetary aggregates reflected developments in the rest of the economy, notably the fiscal stance. For this reason, monetary policy shocks per se, i.e., exogenous changes in the policy stance are not a likely candidate for driving inflation. However, it also implies that monetary aggregates accommodated fiscal shocks and played a role in their transmission.

Imported inflation

14. Imported inflation is another likely candidate that can help account for fluctuations in prices. Figure 1.5 displays imported inflation, measured as an import-weighted index of inflation in the CEMAC's main trade partners multiplied by their nominal exchange rate vis-à-vis the FCFA: From Figure 1.5, it can be seen that imported inflation leads domestic inflation by two or three quarters. It can therefore help predict domestic prices at a relatively high frequency.

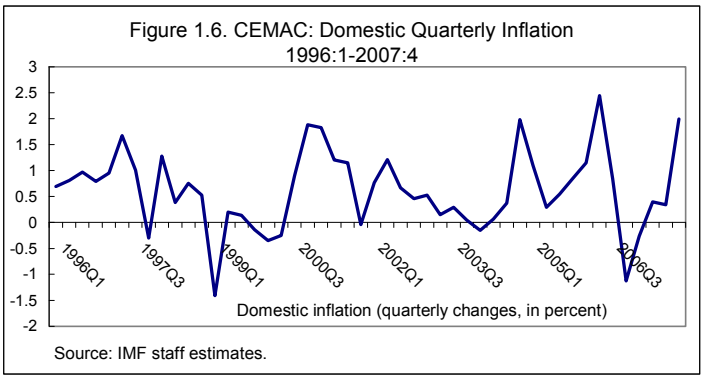
Figure 1.5. CEMAC: Domestic and Imported Inflation
1996:1-2007:4



Source: IMF staff estimates.

Domestic supply shocks

15. Finally, inflation displays large one time changes from one quarter to the next, as shown in Figure 1.6. While some of these quarterly changes reflect the lower frequency fluctuations in the fiscal stance, part of this high frequency variance is likely due to domestic supply shocks, such as changes in domestic agricultural production. Indeed, the low average inflation observed in 2007 is attributed in part to agricultural developments in Chad. These high frequency changes could also reflect changes in regulated prices and/or measurement error, which is an important issue in the region. However, we will not dwell on those issues for the purposes of this analysis.



16. The previous analysis has indicated that there are three major likely candidates for understanding inflation developments in the region: fiscal policy shocks, shocks to imported inflation and domestic supply shocks. It is important to identify the contribution that each one of these shocks has made to the overall variance of inflation. We will estimate such contribution through two alternative methods. First, we estimate a semi-structural VAR for CEMAC variables. Second we compare those results with an estimated DSGE model that incorporates these shocks and the channels through which they operate.

C. Assessment of Structural Shocks with a Semi-Structural VAR

17. In light of the evidence presented in section B, we estimate a vector auto regression (VAR) with two lags and five variables: imported inflation, the fiscal stance, non-oil GDP growth, money growth and inflation. We make the following identifying assumptions. First, we assume that imported inflation is exogenous relative to the other variables. Second, we identify fiscal shocks by assuming that these respond contemporaneously to shocks in imported inflation only.[6] Finally, we interpret domestic supply shocks as unexpected changes in inflation that are orthogonal to contemporaneous movements in all other variables. This

[6] The use of VARs to identify exogenous changes in fiscal policy and trace their effects through the economy starts with Blanchard and Perotti (1998). Alternative measures rely on a narrative approach to identification, such as in Ramey and Shapiro (1996).

identification scheme is likely to lead to a downward bias in the estimated contribution of supply shocks to overall inflation.[7][8]

18. First we present the variance decomposition of all variables by type of shocks. Since the VAR is only semi-structural, the contribution of the three shocks need not add up to one. Imported inflation accounts for about 36 percent of the volatility of inflation, while shocks to the fiscal stance account for about 20 percent and domestic supply shocks explain an additional 16 percent. Fiscal shocks also account for a sizeable fraction of the volatility of money growth, consistent with Figure 1.3.

19. The variance decomposition only provides the contribution of fiscal shocks, rather than the contribution of the fiscal stance itself. Indeed, part of the contribution of higher import prices to inflation may be operating through an endogenous response in the fiscal stance: higher imported inflation, if it represents an appreciation of the dollar, may fuel an expansionary fiscal response since oil revenues are increasing in FCFA. The large role of imported inflation in the VAR may thus be explained in part by the fiscal expansion that may follow, and the share of money growth volatility that is accounted by the latter attests to that hypothesis.

Table 1.1. CEMAC: Variance Decomposition by Type of Structural Shocks

	Fiscal shocks	Shocks to imported inflation	Domestic supply shocks
	Share of total volatility (in percent)		
Inflation	18.23	36.25	15.9
Money Growth	27.71	57.35	0.42
Non-oil GDP growth	30.51	36.25	9.4
Fiscal stance	37.29	42.33	5.3
Imported inflation	100	0	0

Source: IMF staff estimates

20. Figure 1.7 presents impulse response functions for all variables (except imported inflation) following a one percentage point increase in our measure of the fiscal stance, with the 10th and 90th percentile of their distribution.[9] Inflation increases by as much as 1.7 percent after five quarters, while money growth increases by almost 7 percent and non-oil GDP increases by about 1.5 percent. These estimates are in line with the comovement we observed in previous graphs and suggest that the non-oil fiscal stance is an important source of aggregate demand volatility in the region.

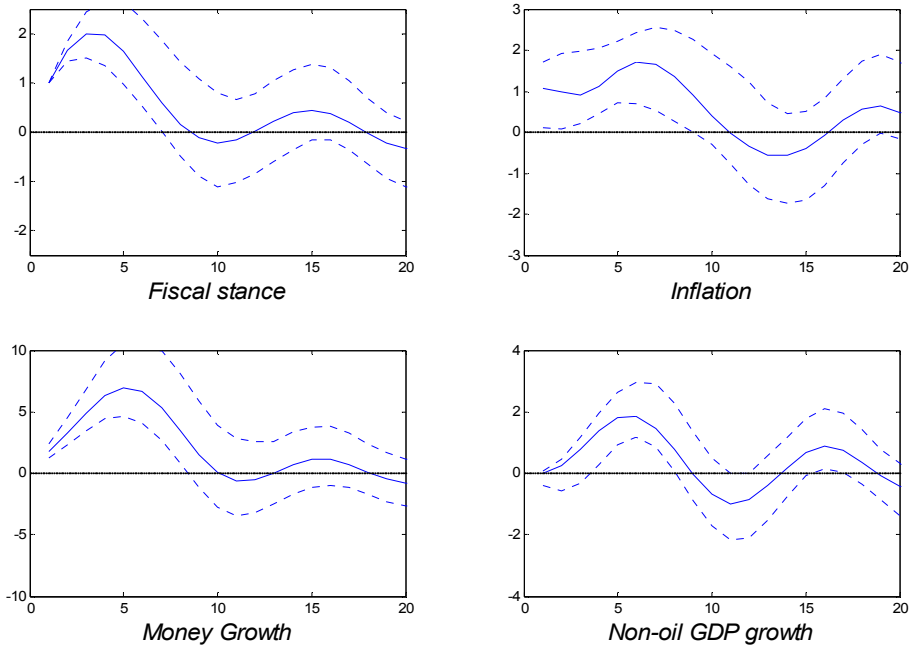
[7] The VAR is estimated with quarterly data for the period 1998:1-2007:4; the annual statistics for the fiscal stance and non-oil GDP growth are interpolated to create quarterly time series.

[8] If oil prices are not well proxyed by imported inflation and have an immediate impact on the fiscal stance, then the current VAR could overestimate the contribution of fiscal shocks to GDP.

[9] Confidence intervals were derived using the bootstrap procedure described in Kilian (1998).

We now describe a macroeconomic model that can help us rationalize the evidence just presented.

Figure 1.7. CEMAC: Impulse Response Functions Following a 1 Percent Increase in the Fiscal Stance



Source: IMF staff estimates.

D. The Model

21. The DSGE model used for estimation is a simplified version of the model in Berg et al. (forthcoming). The model has also been extended along other dimensions, notably the introduction of several types of shocks. This section presents a summary of the equations of the model in log-linearized form (i.e., in percentage deviations from the steady state), organized by economic agent.[10]

Consumers

22. Every quarter, the representative consumer chooses an intertemporal path for consumption (C_t), demands financial assets and money, and makes labor supply decisions. Consumption decisions are given by the now-standard forward-looking IS equation:

[10] For an introducion to DSGE models, see Gali and Gertler (2007) in the case of a closed economy and Gali and Monacelli (2005) in the case of a small open economy.

$$C_t = \alpha_1 * E_t(C_{t+1}) + (1-\alpha_1) * C_{t-1} - \alpha_2 * (R_t - E_t(\pi_{t+1})), \qquad (1)$$

where R_t is the short term nominal interest rate and ($E_t(\pi_{t+1})$) is the expected quarterly inflation rate. Consumers also choose how to allocate consumption between three types of goods: non-traded goods and services (C_t^N), domestic agricultural products (C_t^{NF}) and imported goods (IMP_t). Demand for each is as follows:

$$C_t^N = \chi * p_t^N + C_t \qquad (2)$$
$$IMP_t = \chi * p_t^{IMP} + C_t \qquad (3)$$
$$C_t^{NF} = \chi_{NF} * p_t^{NF} + C_t \qquad (4)$$

Demand depends on the prices of each type of good relative to the overall CPI: p_t^N, p_t^{IMP} and p_t^{NF}.[11] The parameter (χ) refers to the price elasticity of imports and non-traded goods prices, while (χ_{NF}) summarizes the price elasticity of agricultural demand. The allocation of consumption across goods leads to the following equation for inflation (as deviation from steady state inflation π^*) :

$$\pi_t = n_1 * \pi_t^N + n_2 * \pi_t^{IMP} + n_3 * \pi_t^{NF}$$

Imported inflation follows an exogenous AR(1) process:

$$\pi_t^{IMP} = \rho_{IMP} * \pi_{t-1}^{IMP} + u_t^{IMP}$$

Regarding financial assets, consumers choose between domestic and foreign assets (b_t and b_t^*) , subject to a portfolio adjustment cost—measured in terms of changes in holdings of foreign assets—that prevents uncovered interest rate parity from holding in the model. This leads to the following relation between domestic and foreign interest rates (R_t) and (R^*) and the expected rate of depreciation of the nominal exchange rate S_{t+1}:

$$R_t = R^* - \phi * b_t^* + E_t(S_{t+1} - S_t) \qquad (5)$$

---

[11] Relative prices are related to inflation measures as follows:

$p_t^i = p_{t-1}^i - \pi_t + \pi_t^i$, for *i = N, NF, IMP.*

The portfolio adjustment cost, given by the coefficient ϕ, is a proxy for the degree of capital mobility in the model. Finally, demand for real money balances is as follows:

$$m_t = M_t - P_t = C_t - \gamma_3 R_t + z_t^{MD}, \quad (6)$$

Where (z_t^{MD}) is a persistent shift in money demand:

$$z_t^{MD} = \rho_{MD} * z_{t-1}^{MD} + u_t^{MD}$$

The only remaining consumer decision left to describe is labor supply (L_t). We assume that consumers set wages but cannot reset wages every period, and that a certain degree of backward looking indexation takes place, all of which leads to the following Phillips curve for wage inflation (π_t^W):

$$\pi_t^W = \rho_W * \pi_{t+1}^W + (1-\rho_W) * \pi_{t-1}^W + \kappa_W (\frac{1}{\eta} * L_t - w_t + C_t) \quad (7)$$

According to this equation, wages inflation will increase if the labor market is tight (high L_t), if real wages are too low (w_t) or if consumers feel wealthy.

Firms

23. There are three local sectors in the economy: the non-traded sector, the exportables sector and domestic agriculture. The first two sectors produce goods using local labor and have the same production function: $Y_t^i = \alpha * L_t^i$, for $i = N,E$ (as in exportables). However, the similarities end there. Exportable goods are produced by perfectly competitive firms which take the world price of exportables as given. Demand for labor in this sector is given by the following equation:

$$L_t^E = \alpha_E * (s_t - w_t) \quad (8)$$

where s_t is the CPI based real exchange rate ($s_t = S_t + P_t^* - P_t$). Firms producing non-traded goods on the other hand have some degree of market power and set the prices at which they sell their products. Price setting is also subject to nominal rigidities, as well as some degree of indexation to past prices, all of which leads to a standard hybrid Phillips curve for non-traded goods inflation π_t^N:

$$\pi_t^N = \rho_\pi * \pi_{t+1}^N + (1-\rho_\pi) * \pi_{t-1}^N + \kappa_\pi (mc_t^N - p_t^N) \quad (9)$$

Inflation increases if real marginal costs in the non-traded sector increase or if the real price of non-traded goods is too low. Real marginal costs are given by:

$$mc_t^N = w_t - (1-\alpha) * L_t^N \qquad (10)$$

Finally, production of local agricultural goods is assumed as exogenous and following an AR(1) process:

$$Y_t^{NF} = \rho_{NF} * Y_{t-1}^{NF} + u_t^{NF} \qquad (11)$$

Overall GDP is given by the sum of these three sectors, weighted by their steady state shares:

$$Y_t = \lambda_E * Y_t^E + \lambda_N * Y_t^N + (1-\lambda_E - \lambda_N) * Y_t^{NF}$$

The government

24. To simplify, we assume that the government's sole source of revenue comes from oil, which is modeled as an exogenous flow of foreign resources. In addition, we assume that all government spending is focused on the non-tradable sector, which leads to the following equation:

$$p_t^N + G_t = s_t + OIL_t \qquad (12)$$

An increase in oil revenue will lead to an increase in government spending (G_t), all else constant. In addition, a real appreciation of the currency and/or an increase in the relative price of non-tradable will reduce the purchasing power of oil revenues and will lead to a decline in real government spending. Oil revenues follow an exogenous AR(1) process:

$$OIL_t = \rho_{OIL} * OIL_{t-1} + u_t^{OIL} \qquad (13)$$

The central bank

25. In real terms, the central bank balance sheet is given by:

$$m_t = \lambda_{bcb} * bcb_t + (1-\lambda_{bcb}) * (s_t + RES_t) \qquad (14)$$

Bcbt refers to the central bank's net domestic assets and RESt is the level of international reserves. Reserve accumulation is as follows:

$$RES_t = \omega_S * (S_t - S_{t-1}) \qquad (15)$$

Reserve accumulation depends on the degree of exchange rate targeting. In the case of a fixed exchange rate regime such as the CEMAC's regime, ω_S is calibrated to be infinitely large, which implies $S_t = S_{t-1} = 0$. With regard to monetary policy, we explore two alternative rules. Under the first rule, we assume that monetary policy is passive and that open market operations (in terms of their nominal growth) follow an exogenous process, which implies the following equation in real terms:

$$bcb_t = bcb_{t-1} - \pi_t + u_t^{MP} \quad (16)^{12}$$

Such exogenous rule is consistent with monetary policy implementation in the CEMAC region until very recently. We also explore an alternative policy framework, whereby the authorities set short term nominal interest rates, in line with a modified Taylor rule:

$$R_t = \rho_R * R_{t-1} + (1-\rho_R) * (\phi^{MP} * \pi_t - \phi^{RES} * RES_t) + u_t^{MP} \quad (17)$$

Under this rule, the authorities would raise nominal interest rates if inflation is above its long run level or if reserves are too low.[13] This rule can also be used to describe a passive monetary policy if ρ_R is very close to 1, which implies a very strong inertia in policy rates. However, if ρ_R is considerably lower and ϕ^{MP} is high, the rule then describes a more active monetary policy. The latter characterization of policy is closer to the current policy framework but it can only be implemented if capital mobility is sufficiently low (very high ϕ in equation 5). While the first equation is closer to the description of monetary policy during the period we focus on, we present the estimation results using the second rule, assuming a very high ρ_R, as the results with (16) did not lead to plausible results.[14]

Market equilibrium conditions

26. Closing the model requires ensuring that markets clear. There are three equilibrium conditions and one resource constraint (or external balance condition) that must hold at every period. First the labor market must clear:

$$L_t = \lambda_{L^E} * L_t^E + (1-\lambda_{L^E}) * L_t^N$$

Second, the non-traded goods market and the market for locally produced agricultural products must also clear:

$$Y_t^N = \lambda_{C^N} * C_t^N + (1-\lambda_{C^N}) * G_t^N$$

---

[12] This equation is derived from the authorities target for net domestic assets (in level and in nominal terms): $B_t^{CB} = (1+g) * B_{t-1}^{CB} * e_t^{MP}$. Deflating both sides by the current prices (P_t) and log-linearizing yields equation (17).

[13] For a discussion on properties of monetary policy rules, see the treatise by Woodford (2003).

[14] The main problem is that, under the first rule, the model imposes a tight relation between money growth and the fiscal stance. While this relation holds reasonably well in the data, it does not hold perfectly, especially over very high frequencies. As a result, the algorithm that maximizes the likelihood function will find that monetary policy shocks have been very large during this period, which will then lead to implausible results.

$$Y_t^{NF} = C_t^{NF}$$

Finally, external balance requires ($\overline{X}$ refers to the steady state level of variable X):

$$\overline{IMP} * (IMP_t + p_t^{IMP}) - \overline{Y^E} * (Y_t^E + s_t) = \overline{OIL} * (OIL_t + s_t) - \overline{b^*}(b_t^* - \frac{1}{\pi^*} b_{t-1}^* + \frac{\pi^* - 1}{\pi^*} * s_t) + \ldots$$

$$\ldots - \overline{RES}(RES_t - \frac{1}{\pi^*} RES_{t-1} + \frac{\pi^* - 1}{\pi^*} * s_t)$$

Where $\overline{b^*}$ refers to net foreign assets, which are governed by the interest parity equation described in (5).

E. Calibration, Estimation and Results

27. The model aims to understand how the fiscal stance, fuelled by higher oil revenues, can lead to higher inflationary pressures and be a source of monetary creation without direct monetary financing. We estimate the model, through Bayesian maximum likelihood, in order to recover parameter values and provide a model-based variance decomposition of inflation, which we can then compare to the VAR results from section B.[15] The estimation relies on similar data as that presented in section C, except that it includes a measure of short term interest rates (the rate at which BEAC auctions 7 day deposits) and excludes GDP.[16]

28. The model is highly parameterized (33 parameters in total) plus the standard deviation of all five shocks. We calibrated 19 of these as indicated in Table 1.2. Most notably, we assume that short term interest rates have little impact on domestic absorption. In addition, we limit capital mobility to its minimum and ensure that the fixed exchange rate regime holds at all times.

Table 1.2. Calibration

alpha2	0.001	phi_RES	-0.0050
chinf	0.020	lambdaLn	0.6000
n1	0.300	bc/GDP	0.1000
n2	0.500	IMP/GDP	0.2000
phi	10000000	OIL	0.2000
gamma3	-0.300	b*	0.0000
lambdaE	0.1800	infl*	0.0050
lambdaN	0.320	RES	0.0900
omegaS	10000000	YE	
phi_MP	1.050		

Sources: Staff estimates

[15] Bayesian methods are becoming increasingly popular methods to estimate DSGE models, given new computational methods developed to estimate posterior distributions. See Smets and Wouter (2005) and Kiamenik et al. (2008), among many others.

[16] Including GDP in the estimation would have required adding an additional structural shock to the system and was therefore discarded.

29. Regarding the estimated parameters, prior distributions and the posterior mode are presented in Table 1.3. In general, the posterior modes are close to the prior mean for many parameters, especially those that describe the comovements between variables. This implies that the data is not very informative with regards to the values of these parameters. On the other hand, measures of persistence and the standard deviations of shocks do deviate from their priors. These results are sensitive to the numerical method used to maximize the likelihood and should be interpreted with caution.[17]

Table 1.3. Results from Posterior Maximization

Parameters						
	Prior mean	mode	s.d	. t-stat	prior	pstdev
alpha	0.600	0.7368	0.9272	0.7946	inverse gamma	0.100
alpha1	0.520	0.5049	0.2641	1.9118	inverse gamma	Inf
alpha2	0.001	0.0004	0.0008	0.5303	inverse gamma	0.010
alphae	30.200	30.1569	2.1491	1.3615	uniform	17.205
chi	1.250	1.2570	0.8090	1.5539	uniform	0.433
eta	2.000	2.0045	1.0121	1.9806	inverse gamma	Inf
kappapi	0.525	0.5285	0.1660	3.1831	uniform	0.274
n3	0.205	0.0792	0.0609	1.3008	uniform	0.113
rho_A	0.700	0.7162	0.0046	156.45	gamma	0.200
rho_MD	0.800	0.7875	0.0693	11.362	gamma	0.200
rho_MP	0.900	0.9900	0.0001	8670.7	gamma	0.200
rho_nf	0.700	0.8973	0.0196	45.808	gamma	0.200
rhopi	0.500	0.4870	0.0029	170.29	gamma	0.200
standard deviation of shocks						
	Prior mean	mode	s.d	. t-stat	prior	pstdev
uA	0.100	0.3215	0.0562	5.7246	inverse gamma	Inf
uIMP	0.100	0.0158	0.0118	1.3371	inverse gamma	Inf
uMD	0.005	0.0140	0.0397	0.3537	gamma	0.001
uMP	0.005	0.0007	0.0103	0.0681	inverse gamma	Inf
uNF	0.000	0.0001	0.0003	0.4250	inverse gamma	Inf

Log data density Laplace approximation is 465.439108

30. Table 1.4 presents the variance decomposition of inflation according to the model. The fiscal stance accounts for 20.7 percent of quarterly inflation, but only 8 percent of quarterly money growth, while the share of inflation explained by imported inflation decreases substantially. Supply shocks (agricultural production in the model) now account for most of the inflation volatility. In contrast with the VAR results, these estimates are likely overstating the contribution of supply shocks.[18]

[17] More work is needed to assess the robustness of these results. This is left for future research.

[18] As these shocks help explain a large share of inflation volatility without leading to movements in other observed variables, the maximization of the likelihood will lead to the results observed above.

31. Finally, Figure 1.8 presents the impulse response functions in the model following a one percentage point increase in the fiscal stance. The paths are similar to those found in the VAR, except that the responses display less persistence and the growth rate of money is smaller. Overall, the results of the model-based approach are broadly similar to those of the VAR, which lends robustness to the view that fiscal policy is an important source of inflation.

Table 1.4. CEMAC: Variance Decomposition by Type of Structural Shocks

Shocks to the:	Fiscal stance	Imported inflation	Money Demand	Monetary Policy	Agricultural production
			Share of total volatility (in percent)		
Inflation	20.7	12.5	0.0	5.4	61.4
Money growth	7.9	4.8	61.4	2.3	23.6
Fiscal stance	100.0	0.0	0.0	0.0	0.0
Imported inflation	0.0	100.0	0.0	0.0	0.0
interest rates	4.7	0.2	0.0	94.5	0.6

Source: IMF staff estimates.

The impact of fiscal shocks on the CEMAC region: a summary according to the DSGE

32. One of the advantages of using a DSGE to analyze the determinants of inflation is that it provides a framework to understand how these shocks are propagated through the economy. This subsection elaborates on the impact of an increase in the non-oil fiscal deficit according to the model.

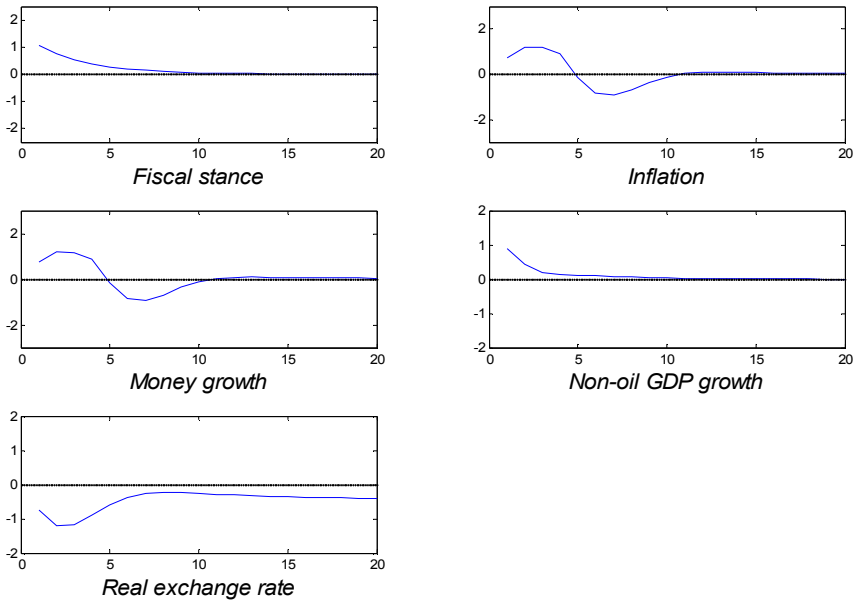
33. Provided it focuses on the non-traded sector, an increase in government spending will increase the demand for these goods, causing an increase in non-traded production and an in that sector's inflation. In addition, the increase in non-traded goods production raises the demand for labor in that sector and will crowd out the non-oil exportable sector through higher wages. The increase in the price of non-traded goods will lead consumers to substitute those goods for imports.

34. In addition to the real effects just mentioned, if the increase in government spending is financed out of oil revenues, then greater spending will lead a monetary injection. This is because—prior to the increase in spending—oil revenues are first accumulated as reserves. The initial impact on the money supply is zero, as the increase in reserves is fully offset by an increase in government deposits at the central bank. When the oil revenue is spent on local goods and services, government deposits are drawn down and money is created as a result, which accommodates the increase in non-traded goods inflation. The increase in imports just mentioned earlier however partially offsets the monetary expansion.

35. An alternative, complementary, view of this process is that an increase in the demand for the non-traded goods requires a real appreciation, which under a peg can only be brought about by overall inflation. As monetary policy is passive, the monetary injection that follows helps bring about the equilibrium real appreciation.

36. The overall implication from this analysis is that the implicit real exchange rate objectives of national governments must be consistent with the inflation objectives of the regional central bank.[19]

Figure 1.8. CEMAC: Impulse Response Functions following a 1 Percent Increase in the Fiscal Stance



Source: IMF staff estimates.

F. Conclusion

37. The results presented in this paper have highlighted the role of the fiscal stance in driving inflation, in addition to other shocks that are relevant for the region. This suggests that greater coordination between fiscal and monetary policy is required to ensure price stability in the region.

38. The paper has also presented and estimated a general equilibrium model to understand the channels through which fiscal policy affects inflation. This tool could provide useful for the BEAC when assessing its policy options. In particular it could simulate alternative paths for the economy under an alternative—and more active—monetary policy.

[19] This analysis here is similar to the discussion in Berg et al. (2007) regarding the issues of spending and absorption of external aid.

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II. Excess Liquidity and Private Sector Credit in the CEMAC: A Role for the BEAC?[20]

A. Introduction

39. **The CEMAC is a currency union with a fixed exchange rate regime, but limited capital mobility provides some scope for monetary policy actions**.[21] The prevalence of large nominal shocks due to the region's dependency on oil exports provides the rationale for such actions (Deléchat, Ramirez and Veyrune, 2008). Economic costs of inflation volatility can be significant (see Rother, 2004). Given the exchange rate peg, movements in inflation also have direct implications for the region's real effective exchange rate and competitiveness (Diop, Dufrénot and Sanon, 2008).

40. **Since May 2007 the region's central bank, the BEAC, has been managing liquidity more actively than in the past and is considering a new framework for monetary policy and liquidity management**. The BEAC has been actively absorbing all of the liquidity put forward by commercial banks for negative auctions, and reserve requirements were increased in March 2007. The BEAC is also considering to formally adapt its monetary programming exercise to a situation of excess liquidity by defining specific liquidity absorption objectives instead of refinancing ceilings. Although excess liquidity has so far failed to translate into credit growth and inflation (see Chapter I), abundant liquidity remains a risk for future inflation, financial sector stability, and efficient financial intermediation and monetary policy transmission.

41. **The paper investigates whether and how the BEAC could contribute to maintaining stable inflation in the CEMAC region by controlling banking sector liquidity.** Given the fixed exchange rate regime and low degree of financial market development, monetary policy in the CEMAC can operate mainly via the credit channel. There are few studies of monetary policy transmission in the region,[22] probably in part due to severe data limitations which limit the use of traditional VAR analysis. This paper uses a unique panel database from the Central African Banking Commission (COBAC) of CEMAC banks between 2000 and 2007 to investigate banks' strategy regarding excess reserves accumulation and the impact of excess liquidity on the supply of loans to the private sector.

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[20] Prepared by Corinne Deléchat and Romain Veyrune.

[21] Although in principle the movement of capital is fairly free, a number of restrictions, actual or perceived by banks and other residents, severely limit capital mobility for the average person or company. The Technical Note on Systemic Liquidity prepared during the 2006 Financial Sector Assessment for the CEMAC region analyses in more detail de facto capital account restrictions (IMF, 2006).

[22] See for example Beguy (2007), which analyzes monetary policy transmission in Cameroon, Chad and Gabon.

If there is a link between liquidity and credit, the BEAC could indeed affect credit by manipulating bank liquidity.

42. **The main findings of the paper suggest that the credit channel could potentially be important in the CEMAC**. Involuntary excess liquidity does indeed lead to higher lending—albeit with a lag. However, results also suggest that the bulk of banks' excess liquidity is held for precautionary motives, due to the short-term maturity of bank resources and weaknesses in the business environment. This partly explains why the credit channel does not fully operate in the CEMAC, as evidenced by the stagnating levels of private sector credit. An enhanced liquidity management framework, continued improvements in the macroeconomic environment, greater financial sector depth, and the removal of structural obstacles to credit development, all can in time lead to more effective transmission of monetary policy through the credit channel.

B. Recent Developments in Money, Bank Liquidity, Credit and Inflation

Sources of liquidity creation in the CEMAC

43. Liquidity creation in the CEMAC is mostly driven by factors beyond the control of the monetary authorities:

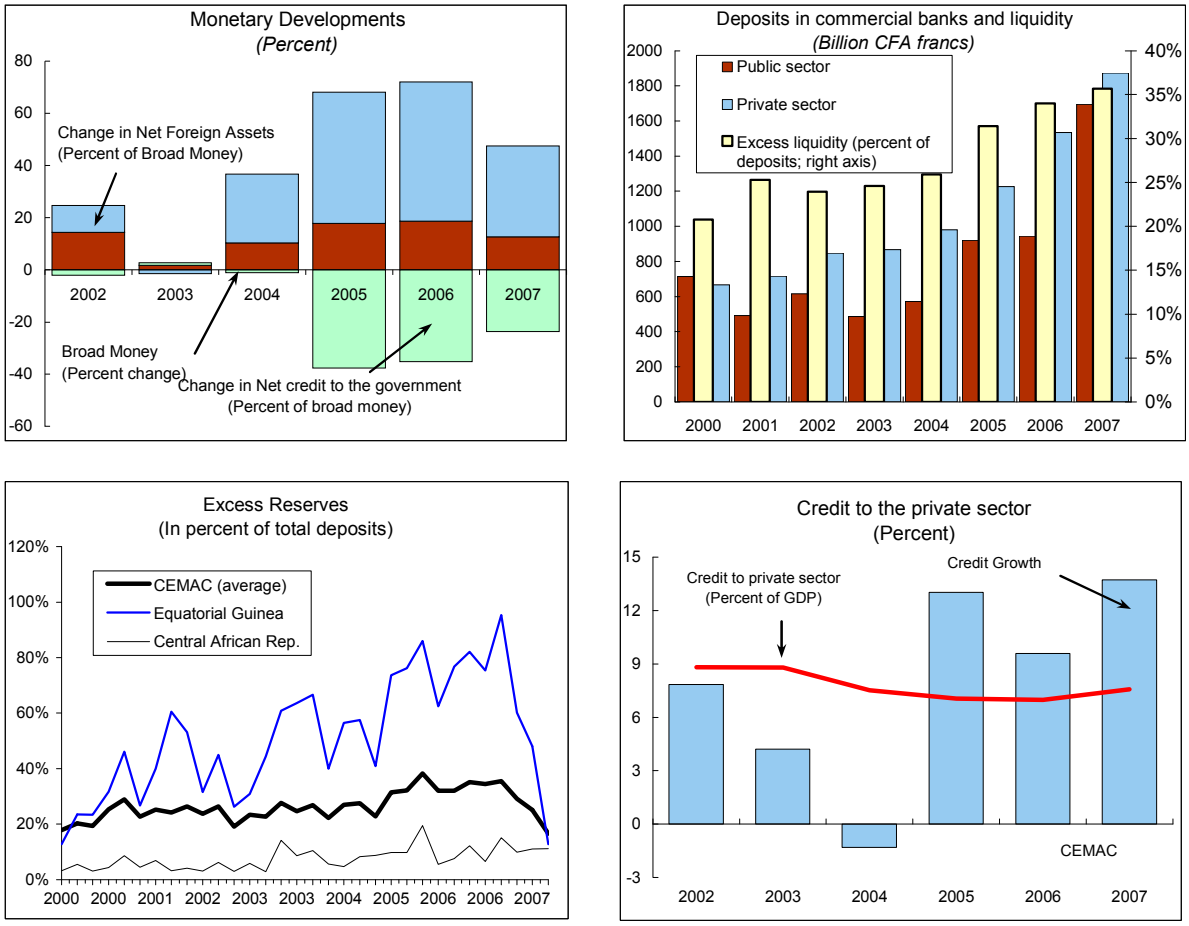
- **Credit to the government.** Until the late 1990s, this has been the main source of liquidity creation. The governments in the region are allowed to receive credits from the BEAC (statutory advances), limited in principle to 20 percent of previous year's tax revenue. Governments have made extensive use of this facility for cash flow management and deficit financing. Since 2000, the fiscal position of the oil-exporting countries improved significantly, allowing them to repay the BEAC advances and constitute net deposits at the BEAC. Nevertheless, poor cash management and idiosyncratic shocks have led most countries (with the exception of Equatorial Guinea) to continue to make use of BEAC advances in spite of fiscal surpluses (BEAC, 2008).

- **Net foreign assets.** With the surge in oil prices since 2000, the CEMAC has experienced large oil inflows[23], which have translated into a rapid increase in foreign assets. Since 2004, NFA growth has taken over government financing as the main source of liquidity creation in the region (Figure 2.1 and Table 2.1). However, the increase in NFA has not translated into a commensurate increase in broad money, as governments have kept deposits at the BEAC. Government deposits in commercial banks also increased, a significant contribution to bank's excess liquidity. These

[23] All CEMAC members but Central African Republic are oil exporters. In 2007, oil accounted for about 40 percent of regional GDP and 86 percent of exports.

deposits partly represent government financing of public enterprises and local administrations, and are linked to suboptimal cash management practices – in spite of a push by BEAC for governments to move to Single Treasury Accounts at the BEAC, the improvement is slow. The increasing oil revenue has also led to an increase in private sector deposits, as governments started repaying arrears to domestic suppliers.

Figure 2.1. CEMAC: Recent Trends in Money, Liquidity and Credit



Sources: BEAC, IMF, *International Financial Statistics*; and IMF staff calculations.

Text Table 2.1. CEMAC: Monetary Survey, 2002–07

	(Contribution to the annual broad money growth)					
	2002	2003	2004	2005	2006	2007
Net foreign assets	10.3	-1.4	24.1	50.4	53.3	34.8
Bank of Central African States (BEAC)	9.2	-0.8	19.7	47.2	50.6	22.3
Commercial banks	1.1	-0.6	4.4	3.2	2.7	12.5
Net domestic assets	4.2	3.1	-10.1	-32.6	-34.6	-22.2
Net credit to government	-2.1	0.9	-10.8	-37.6	-35.3	-23.7
Net credit to public agencies	-1.9	0.8	-0.3	-0.7	-1.3	-1.3
Net credit to private sector	4.7	2.4	1.6	6.7	4.7	6.3
Other items, net	3.4	-1.0	-0.6	-1.1	-2.8	-3.4
Broad money (Annual growth, percent)	14.4	1.7	14.0	17.8	18.7	12.7
Currency outside banks	2.3	-1.7	5.0	4.2	4.1	2.1
Bank deposits	12.1	3.4	8.9	13.5	14.6	10.5

Sources: BEAC; and IMF staff estimates.

Excess liquidity, credit and inflation

44. **As a result, excess liquidity has become a pervasive phenomenon in the region.** Excess reserves are commonly defined as the unremunerated banks reserves at the central bank beyond regulatory limits and bank cash. This phenomenon became widespread in sub-Saharan Africa during the second part of the 90's although it has been particularly strong in the CEMAC. Excess liquidity in the region has sharply increased, peaking at 35 percent of total deposits as of end-March 2007, although there are significant differences across CEMAC member countries (see Figure 2.1).[24]

45. **Excess reserves have a voluntary and an involuntary component**. Banks may want to voluntarily hold reserves beyond required amounts to accommodate possible liquidity shocks. High macroeconomic volatility, leading to high deposit volatility, would thus explain why banks may want to keep precautionary reserves above the level required by the monetary authorities to accommodate possible liquidity shocks (Agénor and El-Aynaoui, 2008). Saxegaard (2006) finds indeed that the volatility of private sector deposits is one of the main determinants of voluntary reserves in the CEMAC.[25] Between 2000 and 2007, demand deposits in the CEMAC followed an increasing trend (see Figure 2.1) but also fluctuated by about +/- 35 percent around the average (Text Table 2.2).

[24] See Chapter I in SM/07/212 for details on liquidity developments, and the monetary policy stance to 2006.

[25] Surprisingly, Saxegaard also finds that an increase in the volatility of government deposits leads to a decline in precautionary reserves.

46. **Involuntary excess liquidity may be due to both cyclical and structural factors (**Agénor and El Aynaoui, 2008)**.** Cyclical factors include for example inflation, which increases uncertainty about the value of collateral and thus leads to higher risk premia and a contraction in credit demand, implying an involuntary accumulation of excess reserves. Large capital inflows or a privatization program can also increase involuntary reserves by increasing the levels of liquidity in the banking system. Structural factors include a low degree of financial development, which limits opportunities for portfolio allocation, and risk aversion of banks leading to high risk premia and a low supply of credit.[26] Agénor and El-Aynaoui (2008) also note that *"the degree of risk aversion, in turn, may be directly related to chronic macroeconomic instability, and this may explain a positive correlation between high inflation and excess liquidity*" (p.4).

Text Table 2.2. CEMAC: Deposit Volatility 2000–07
(In percent unless otherwise indicated)

Average annual deposits (Million CFA francs)	1,784,223
Standard deviation (Million CFA francs)	608,130
Coefficient of variation	34.1
Largest drop in deposits/Reserves	80.0
Largest drop in deposits/End-period reserves	39.5

Sources: BEAC/COBAC; and IMF staff calculations

47. **So far, the surge in liquidity held by banks has failed to be reflected into substantially higher private sector credit**. The banking system was not able to intermediate such an increase in resources. A number of obstacles to formal banking sector credit growth in the CEMAC have been identified (see 2006 regional FSAP; Ghura, Kpodar and Singh, 2008, forthcoming).

- The supply of bankable projects is limited. This is due to lack of financial information to analyze the projects, very small size projects entailing disproportionate administrative cost, and difficulties enforcing contracts and mobilizing collateral;

- The demand of loans for cash flow management from the government and large private companies shrank because of general improvement of the liquidity situation.

- The lack of long term savings and long term refinancing in the region imply that liquidity mismatches could arise if the banks were to extend their supply of longer term loans.

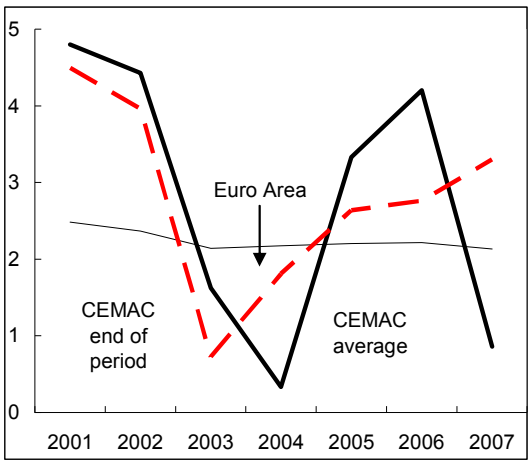
- For small and medium-sized enterprises, the lack of creditor information, an unfavorable judicial environment that makes it difficult to enforce property rights and execute guarantees, and the relatively small size of projects with low expected

[26] In the CEMAC context instead of low demand for credit more structural factors may be at play. For example, (see Agenor, Aizenmann and Hoffmaister, 2008)

returns, are the main factors explaining their difficulties in obtaining bank loans (IMF, 2006).

48. **Inflation, which has traditionally been low, picked up in 2004, mostly driven by higher government spending, imported inflation and idiosyncratic supply shocks in individual countries** (also see Chapter I). Inflation in the CEMAC has been higher and more volatile than in the euro area, although in the long-run both should be aligned as long as productivity growth differences are insignificant. Inflation was unexpectedly low in 2007, but the food and fuel price increases started to be manifest toward end-year in regional CPI inflation and should lead to inflation above the 3 percent convergence criterion in 2008 (Figure 2.2).[27]

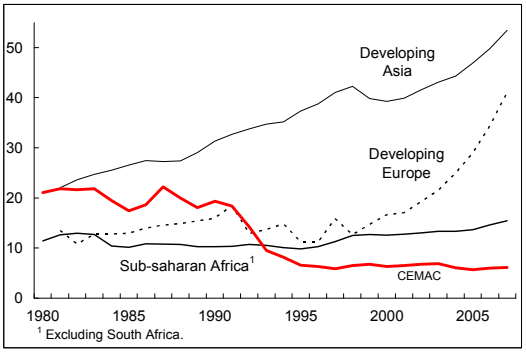
Figure 2.2. CEMAC and Euro Area Inflation
(Percent change)



Sources: BEAC, IMF, *International Financial Statistics*; and IMF staff calculations.

49. **It is difficult to establish a link between credit growth and inflation in the region, but there seems to be some (albeit weak) correlation.** Credit to the private sector, at about 7 percent of regional GDP, remains one of the lowest in the world (Figure 2.3). Compared to WAEMU, credit grew slightly more in CEMAC although bank resources (bank reserves) increased four times faster in CEMAC that in WAEMU. Nonetheless, credit growth appears to have picked up since 2005 and accelerated in 2007 (See Figure 2.1). There is a small significant correlation between the growth of private sector credit and inflation in the CEMAC, and none in the WAEMU (Figure 2.4).

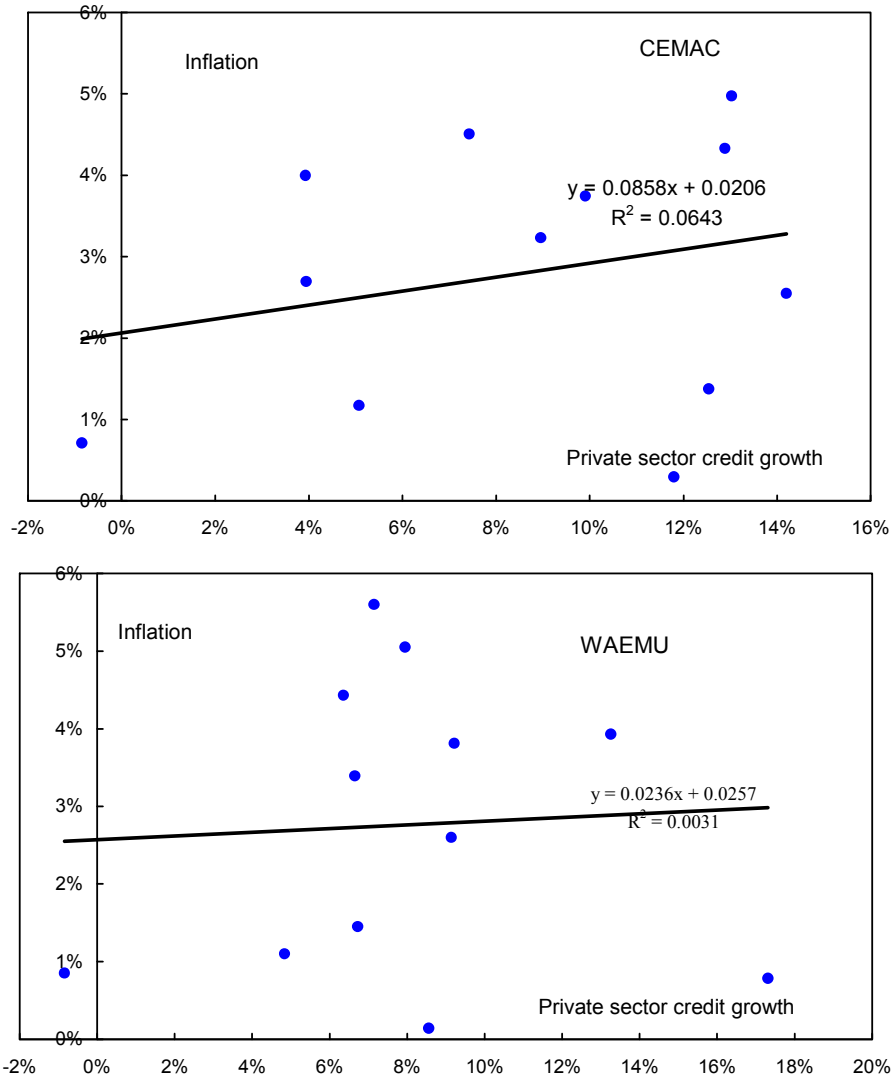
Figure 2.3. Credit to the Private Sector to GDP in
Selected Regions (percent)



Sources: BEAC, IMF, *International Financial Statistics*; and IMF staff calculations.

[27] The lack of harmonized consumer price statistics for the region and severe data weaknesses in some countries may impede an accurate analysis of price developments in the region.

Figure 2.4. CEMAC and WAEMU: Credit Growth and Inflation (2000–07)



Sources: IMF, *International Financial Statistics*; and IMF staff calculations.

C. Toward an Enhanced Liquidity Management Framework

50. **There are a number of risks associated with growing excess liquidity, making a case for more active liquidity management by the BEAC**:

- Financial disintermediation, as excess liquidity is costly to hold and lowers banks' profitability;
- Inflationary pressures if the liquidity suddenly leads to rapid credit growth, or large capital outflows if negative shocks affect confidence in the exchange rate regime;
- Banking sector instability as banks may be tempted to take on more credit risk to maintain profits;

- Loss of overall monetary policy control; and

- Lower efficiency of monetary policy transmission through the credit channel (as will be discussed further below).

51. **However, the role that the BEAC can play in managing liquidity is limited by the fact that the main sources of liquidity creation are beyond its control.** Given the magnitude of oil-related inflows, the potential cost of more active liquidity absorption by the BEAC sets limits on the share of these inflows that can be actively sterilized. "Quasi-sterilization" in the form of government deposits will therefore continue to play an important role, but at present the BEAC has no control over the share of the inflows that governments choose to save or spend. Better cash flow management by CEMAC member countries, more effective regional coordination between fiscal and monetary policies, and a common understanding on requirements of a regionally sustainable fiscal stance, accompanied by better incentives for governments to repatriate and generate long-term savings at the BEAC would be key elements.

52. **The BEAC is considering a new framework for reserves and liquidity management that would help increase the predictability of liquidity movements.** Based on MCM TA recommendations, the BEAC is considering establishing a strategic asset allocation (SAA) consisting of a liquidity and an investment portfolio. The size of the liquidity portfolio would be the amount of reserves judged adequate to cover balance of payments needs. The investment portfolio would consist of longer-term oil savings, and ideally each government should own the corresponding amount of foreign exchange. Following an agreement on the size of both portfolios, and the target amount of monetary reserves, monetary programming could then be modified to define more operational liquidity management objectives, based, for example, on an indicative short-run reserve money target. The BEAC would commit to intervene in cases of both tight and excessive liquidity. However, both more effective and market-based monetary policy instruments and a clear understanding of the channels of monetary policy transmission in the CEMAC would be needed to support more active and effective interventions.

BEAC liquidity management

53. **The BEAC has a limited number of policy instruments at its disposal.** The instruments are liquidity injections and withdrawals through positive and negative auctions, interest rates and reserve requirements. Until early 2007, the main instrument of monetary policy has been reserve requirements, which were initiated in 2001 and, starting in 2002, have been differentiated across CEMAC member countries according to liquidity conditions. The lack of market-based instruments and the ad hoc nature of interest rate changes means that interest rates are not an effective policy instrument at this stage, though they can be used to signal BEAC's stance. However, BEAC policy rates are now below reference rates for the Euro area, an indication that monetary policy may be too loose. Until 2006, negative auctions

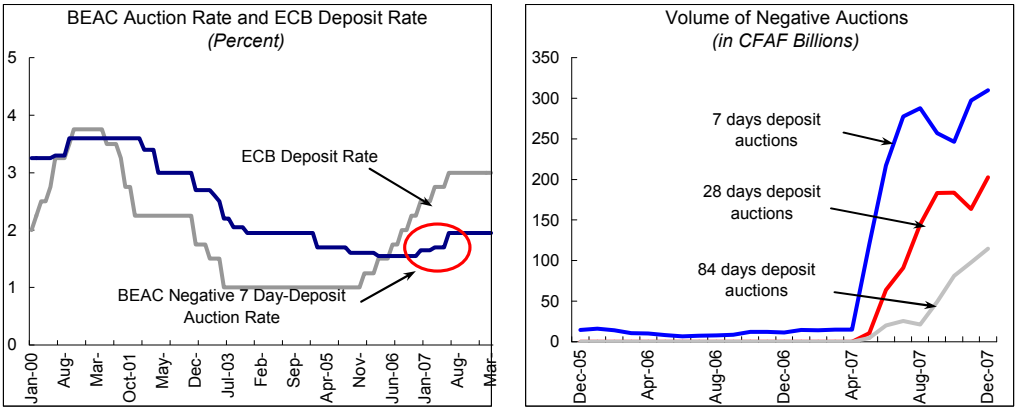
were used very rarely and on an ad hoc basis. Indeed, in spite of the growing excess liquidity, the net liquidity absorption was negative in 2006.

54. **The BEAC's stance in response to the rising liquidity has, until recently, been mostly passive.** The perceivably weak link between liquidity and inflation and a clear political wish to foster credit growth encouraged the BEAC to tolerate a high level of liquidity in the region. Furthermore, the BEAC is still ill-equipped to forecast liquidity and react in the very-short run to liquidity shocks. This may be due to the lack of market instruments such as central bank or treasury bills. However, the most fundamental factor hindering a market-based approach is fact that the interbank market remains segmented across countries and shallow, with very low interbank trading volumes. The differentiated reserve requirements and refinancing ceilings across CEMAC members, and *ad hoc* liquidity injections and withdrawals, combined with high excess liquidity have also stifled the development of financial markets and regional financial integration.

55. **More active liquidity withdrawals since May 2007 through stepped up negative auctions have succeeded in mopping up significant amounts of banks' excess liquidity**. The interest rate on negative 7-day auctions was increased from 1.65 to 1.95 percent, and all banks in the region were allowed to participate (Figure 2.5). Excess liquidity declined by 50 percent between its peak of the first quarter of 2007 and the end of the year, moving from 35 to 17 percent of total deposits. The decline was particularly impressive in Equatorial Guinea, where excess liquidity went from 95 to 13 percent of total deposits.

56. The BEAC has also reactivated the project of a regional government securities market. The transition plan for implementation of a regional government debt market was approved in March 2008 by the BEAC Board, and endorsed by the CEMAC Council of Ministers. The plan is to phase out statutory advances and start issuing government T-bills by January 1, 2009. This would provide the basis for financial market deepening while allowing the BEAC to use open-market operations as an instrument of monetary policy.

Figure 2.5. CEMAC: BEAC Liquidity Management



Sources: BEAC, IMF, *International Financial Statistics*; and IMF staff calculations.

Monetary policy transmission

57. **Can monetary policy interventions have some influence on prices and output in the CEMAC, apart from their influence on the supply of credit**? The literature on monetary policy transmission highlights several channels through which a change in monetary policy stance would influence macroeconomic variables (Cecchetti,1995, Bernanke and Blinder, 1992, and Hubbard, 1995). Three main channels are generally identified: (1) interest rate channel; (2) other asset price channel, and (3) bank lending channel (see for example Mishkin, 1996, 2001). In the CEMAC region the low level of financial development and the fixed exchange rate regime severely limit the first two channels, leaving the credit channel as potentially be the strongest channel (see Box 2.1).

58. **However, high excess liquidity in the CEMAC likely weakens monetary transmission through the credit channel**. Within the credit channel, the operation of the balance sheet channel, which works through the impact of monetary policy on creditworthiness of firms, through impact on financial and physical asset prices, is impaired by the inability of banks to assess credit risk accurately – lack of accounting standards and no sharing of risk information. On the other hand, the central bank keeps control over the banks' cash flows, and thus on their ability to lend (credit channel). While in a situation of excess liquidity, this channel is unlikely to operate well (see Saxegaard, 2006), once the excess liquidity has been mopped up it could potentially become more important.

59. **Most empirical studies have used VAR analysis to examine the effect of monetary policy on output and prices.** While the bulk of this literature focuses on developed countries,[28] more recently there has been an increasing number of studies of emerging and transition economies (see for example Hericourt (2005), Dabla-Norris and Floerkemeier (2006) and Ludi and Ground, (2006)).

60. **In the CEMAC region shortcomings in macroeconomic data seriously hamper the analysis of monetary policy in the standard VAR models.** The accuracy of employment, GDP, and CPI measurement is questionable and varies from one member to another. The VAR also uses interest rate changes as an indicator of switches in monetary policy, which is not adapted for the CEMAC because of the absence of an organized money market and interest rate policy. In this paper we chose instead to focus on the behavior of banks and how they manage their balance sheet to study the determinants of voluntary and involuntary reserves on the one hand, and the link between reserves and credit, on the other.

[28] See for example Friedman and Kuttner (1992), Sims (1992), Bernanke and Woodford (1997), Christiano, Eichenbaum and Evans (1999) for applications to the United States, and Bean, larson and Nokolov (2001), Peersman and Smets (2001) for the euro area. These last 2 papers were part of a 2001 research seminar organized by the ECB (http://www.ecb.int/events/conferences/html/policy_transm.en.html).

Box 2.1. Monetary Policy Transmission Channels

Interest rate channel: Because prices are sticky and the long-run interest rate is an average of expected future short-run interest rates, changes in nominal short-run interest rate affect long-run real interest rate, and, therefore, investment and consumption decisions. One can expect a very weak interest channel in the CEMAC because there is no organized financial market in the region, not even an interbank market. The BEAC's central rate defines its refinancing conditions, which makes little sense in a situation of excess liquidity. Moreover, the rates are fixed by official decision and thus do not thus reflect the market situation. Bank interest rates are not directly controlled, but binding maximum lending and minimum deposit rates are in place.

Other asset price channels:

A. **Exchange rate channel**: A change in the supply of local currency will result in a change in the exchange rate, other things being equal. Therefore, the monetary authorities could engineer appreciation (depreciation) that would alters the price of imported goods, the cost of production, and the competitiveness of imports. Ultimately these changes in relative prices will influence investment and consumption. In the CEMAC, the exchange rate is pegged to the euro; therefore, it is the change in the real exchange rate than would influence investment and consumption decisions, i.e., the inflation rate.

B. **Equity price channel:** Increases in money balances beyond the level households and firms wish to hold encourage them to buy more equities, houses and other assets. The consecutive increase in the price of these assets improves the wealth of households and firms (Tobin,1969) and, therefore, changes their decision in term of investment and consumption. This channel is unlikely to operate in the CEMAC due to the absence of capital markets in the region. The BVMAC and the Douala Stock Exchange are in their infancy with virtually no primary issues and no secondary trading. Mortgage markets are not developed either.

Credit channel: asymmetric information in financial markets

A. **Balance sheet channel:** expansionary monetary policy improves firms' cash flow and net worth, lowering adverse selection and moral hazard (Rothschild and Stiglitz (1976)). Consequently, lending, investment and output increase. Conversely, tightening liquidity would force firms and household, whose assets are not fully liquid, to reduce investment and consumption in order to restore the money balances they whish to keep. In the CEMAC region, the lack of accurate information about firms and weaknesses in the legal and judicial framework that make it difficult to execute guarantees and recover borrowed funds probably means that this channel is not strong.

B. **Bank lending channel:** As long as there is not perfect substitutability between retail bank deposits and other sorts of funds, and firms depend on banks' financing, expansionary monetary policies increase bank deposits and reserves, increase the quantity of bank loans available, increase investment and consumption, and output (Bernanke and Gertler (1995)). The CEMAC context fits well with the bank lending channel assumption. First, there are very few alternatives to bank financing in the CEMAC formal sector, suggesting that firms would be dependent on bank financing. Second, the low development of the money market seriously limits the substitution for bank resources. Furthermore, the foreign exchange regulation does not allow bank to arbitrage between local and foreign assets and to borrow aboard. Shifts in monetary policy could be identified as the BEAC influences the excess reserves of the banking system though mandatory reserve requirements and negative auctions.

D. Empirical Analysis

Characteristics of CEMAC banks

61. **This section investigates banks' behavior in term of reserves strategy and loan supply.** Investigating the determinants of the supply of bank loans in the CEMAC region is also important in light of the low level of private sector credit. While a too rapid credit expansion could impair financial sector stability and lead to inflation, some reasonable increases would be warranted to support non-oil GDP growth. The empirical analysis is based on a panel of banks' balance sheet data for the 33 CEMAC banks from 2000 to 2007.

62. **Most of the banks in CEMAC are private and foreign owned.** About a quarter of them belong to regional groups. The largest banking sector, in all respects, is the one of Cameroun, followed by Gabon. In the other countries the sector is very small (Text Table 2.3).

Text Table 2.3. CEMAC: Banking Sector Characteristics

	Banks (Nr.)	Government owned (%)	Foreign owned (%)	Locally owned (%)	Branches (Nr.)	Staff (Nr.)	Assets (% of GDP)
Cameroon	10	23.7	54.5	21.8	97	2734	17.9
Central African Rep.	3	31.2	59.5	9.3	6	229	8.7
Chad	7	17.8	78.9	3.3	17	565	5.6
Republic of Congo	4	5.9	58.4	25.1	4	527	8.0
Gabon	6	31.4	39.0	29.6	33	1368	19.0
Equatorial Guinea	3	20.0	66.2	13.8	10	284	6.8
Total	33	..	..	..	167	5707	13.3

Sources: BEAC, COBAC.

63. **The balance sheet of the banking system displays some heterogeneity across countries.** Demand deposits are generally the main resources, except for Gabon where time deposits are significantly more developed. On the assets side, most systems are very liquid except Central African Republic and Gabon. Gabonese banks have invested in other assets, mainly government bonds while the other banking systems have not. Loans represent the largest share of assets in Central African Republic, and the smallest in Congo (Text Table 2.4).

Text Table 2.4. CEMAC: Summary Banks' Balance Sheet

(end-2007, in percent of total assets)

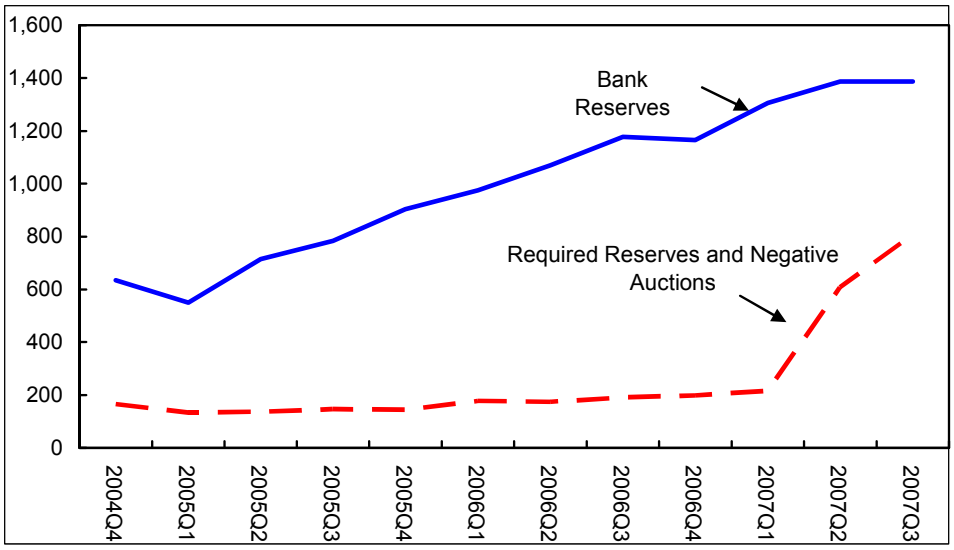
	Cameroon	CAR	Congo, Rep.	Chad	Gabon	Equatorial Guinea
Assets						
Cash & Balances at BEAC	29.5	10.0	42.2	22.7	13.7	37.8
Gross Loans	48.0	76.1	21.8	52.0	36.0	45.2
Other assets	22.5	13.9	36.0	25.3	50.3	17.0
Liabilities						
Due to BEAC	6.3	9.6	3.1	6.0	8.2	5.5
Demand Deposits	59.1	54.7	71.2	69.5	33.6	79.5
Time Deposits	15.7	10.6	9.6	5.5	41.4	1.0
Other Liabilities	11.5	9.5	8.2	6.6	5.6	4.9
capital	7.4	15.7	7.8	12.5	11.1	9.0

Sources: BEAC, COBAC.

64. **Long-term savings are strikingly low.** Short-term liabilities, mainly demand deposits, largely dominate bank resources. They are demand deposits of firms, social security institutions, and the public. Government deposit should now be centralized at the central bank, but some special accounts such as project accounts may remain in banks' accounts. Times deposits, which have a maturity from one month to a year, constitute most of the remaining liabilities. The low level of contractual saving indicate that the banks have not intended to stabilize some of their short term resources, i.e., that they are satisfied with the cost free demand resources (Figure 2.6).

65. **Asset maturities are also to a very large extent short term loans.** In fact, they are mainly withdrawal facilities, which do not have a term *per se*. It is likely that the banks match the maturities of their assets with the maturity of their resources given the difficulties they encounter in refinancing (see Figure 2.6).

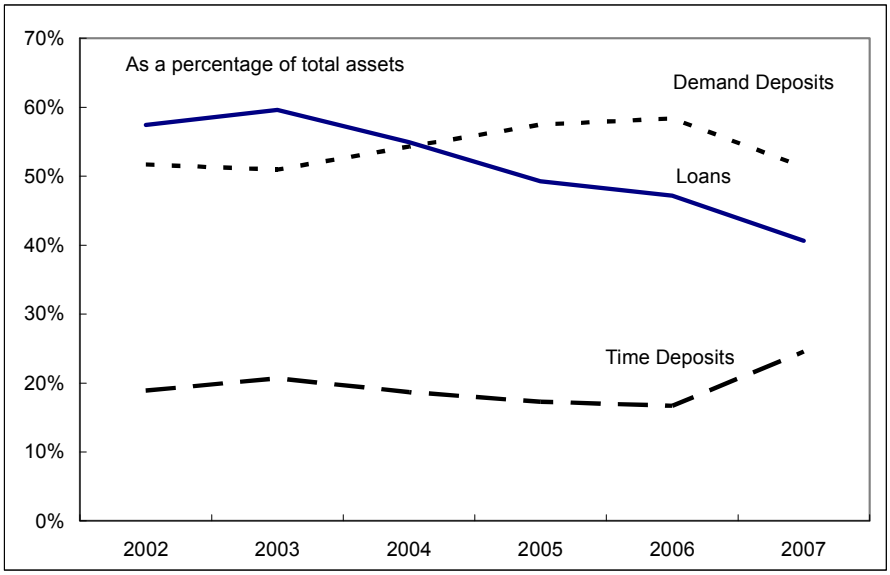
Figure 2.6. CEMAC: Assets and Liabilities Maturity



Sources: BEAC; and IMF staff calculations.

66. **Faced with substantial excess liquidity, banks only partially transformed the increasing resources into loans.** Therefore, credits increased less than deposits and declined as a share of total assets. In compensation, cash and reserves at the BEAC increased (Figure 2.7).

Figure 2.7. CEMAC: Financial Intermediation



Sources: BEAC/COBAC; and IMF staff calculations

Determinants of bank reserves

Model specification

67. **We assume that banks target a level (a percentage) of coverage of their most liquid resources, i.e. demand deposit for precautionary purposes**. As in Agénor and El Aynaoui (2008), the voluntary motive for holding excess reserves is high deposit volatility, so that involuntary reserves are defined as the difference between actual and desired excess reserves. In equation (1) below the second term captures the demand for precautionary reserves. Given the volatility in deposits, banks seek cover for possible liquidity shocks. The first term with the trend in equation (1) can be interpreted as the cyclical (or trend) increase in excess reserves, presumably associated with the increase in oil-related inflows (Agénor and El Aynaoui, 2008). The starting level and rate of increase is allowed to differ across banks. The third term in the equation, the residual, is the deviation of reserves from their targeted amount, after controlling for the trend increase. This can be understood as the structural source of excess liquidity, presumably attributable to high credit risk and a poor enforcement of creditor rights.

$$FR_{i,t} = \alpha_i T_i + \alpha_1 dd_{i,t} + e_{i,t} \qquad (1)$$

- $FR_{i,t}$ are the bank reserves. They are defined as cash in vault and bank deposits at the BEAC beyond the minimum officially required;

- $dd_{i,t}$ are the demand deposits of the bank i at the time t.
- α_1 is the percentage of demand deposit covered by reserves. If the coefficient is constant, the elasticity of reserves to deposits should be close to 1, the bank adjusting proportionally their reserves when the level of deposits changes.
- T_i is a deterministic, bank-specific time trend.
- α_i is the slope of the bank-specific time trend, or the annual rate of increase of excess liquidity.
- $e_{i,t}$ is the deviation from the level of reserves targeted by banks, i.e., the involuntary reserves.

68. **Banks do not have any rational incentives to keep idle reserves except for precautionary purposes.** Therefore, they will adjust their stock of reserves in the next period. The reserves they accumulate may have been influenced by past variation in demand deposits. The involuntary reserves are included in the short-term equation as the deviation in reserve coverage to be adjusted (equation 2). In the short-run equation both time- and bank-specific fixed effects were included.

$$dFR_{i,t} = \alpha_i + \alpha_t + \alpha_1 dFR_{i,t-1} + \alpha_2 dDD_{i,t} + \alpha_3 dDD_{i,t-1} + \beta \hat{e}_{i,t-1} + u_{i,t} \qquad (2)$$

Results

69. **We estimate a two-stage Engle-Granger model, where the deviation from the long-run equilibrium (the target) is adjusted the following period**. The speed of adjustment indicates how closely banks stick to their target. For the long-run equation to hold the series need to be cointegrated. Unit root and cointegration test results can be found in the appendix. All variables are estimated in logs.

70. **The estimates corroborate that banks have an objective of demand deposits coverage.** In the long-term relationship, the elasticity of reserves with respect to demand deposits is about 0.8 (T-statistics indicated in parentheses below the estimated coefficients). From 2001 to 2007, banks have maintained on average enough reserves to cover 40 percent of their demand deposits, reflecting a relative lack of confidence in the regional economic climate. The coefficients on the bank-specific trends

Text Table 2.5. Trend Increase in Excess Liquidity (weighted by total assets)

Cameroon	0.23
CAR	-0.11
Chad	0.12
Congo, Rep.	0.19
Equatorial Guinea	0.25
Gabon	0.18
CEMAC	0.17

Sources: BEAC/COBAC; and IMF staff calculations.

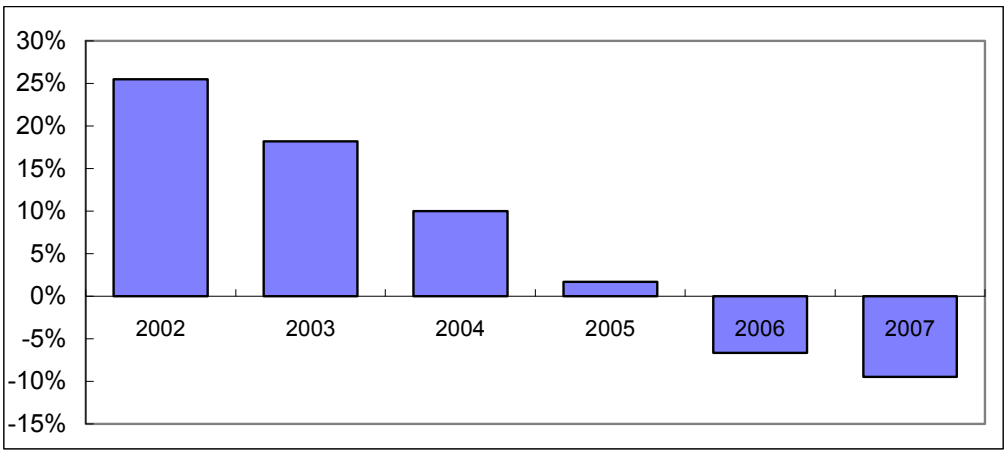
indicate that the average rate of excess reserve accumulation was fast at about 18 percent over the period (bank-specific trends not shown). There were however significant differences by country, with banks from Equatorial Guinea accumulating excess liquidity at an annual rate of 25 percent (using weighted averages of total assets), and Central African Republic banks losing liquidity at a rate of 11 percent per year (Text Table 2.5).

$$FR_{i,t} = 0.18 * T + 0.82 * dd_{i,t} + e_{i,t} \quad (3)$$

(3.8) (74.6)

71. After controlling for demand deposits and a structural increase in excess liquidity, the level of involuntary reserves appears to be declining over the period. The bank-specific residual term in equation (1) shows a steady decline: as a weighted average of total assets, CEMAC banks went from being about 25 percent above their desired level of reserves at the beginning of the period to 10 percent below in 2007 (Figure 2.8). There are however large variations across banks and countries (see Appendix Figure 1).

Figure 2.8. CEMAC: Involuntary Reserves
(as a deviation from target reserves, weighted by total bank assets)



Sources: BEAC/COBAC; and IMF staff calculations.

72. **The short-term equation results also confirm the strong response of reserves to demand deposits.** The error-correction term is negative and strongly significant, indicating a stable, mean-reverting process. Each period banks try to adjust 80 percent of their involuntary reserves (also see Appendix Table 1).

$$dFR_{i,t} = \alpha_i + \alpha_t - 0.11 * dFR_{i,t-1} + 0.96 * dDD_{i,t} + 0.35 * dDD_{i,t-1} - 0.8 * \hat{e}_{i,t-1} + u_{i,t} \quad (4)$$

(-1.21) (5.54) (2.32) (-6.96)

73. **The banks' inclination to hoard reserves in the CEMAC could be explained by the following**:

- The regional interbank market is inactive and has stalled because of settlement issues and the lack of standard collateral to securitize repurchase operations. Also, local banks and the authorities in the region are not used to market practices and, thus, do not have the basic culture to develop an active market.

- Until recently the central bank refinancing procedures were cumbersome and not market-oriented. Recently, deposit auctions have been more frequently used but the pricing mechanism could be improved to reflect better the liquidity situation in the region.

- As for trade, the region does not function as a unified market for the banking system either.

- The capital controls contribute to isolate the banking system from the rest of the world and thus to encourage banks' hoarding behavior.

74. **Overall, enhancing commercial banks' cash flow management would require measures to develop the interbank market, including across CEMAC members.** The project to develop a regional government securities market would help because it would provide collateral for repo operations. Provided an active secondary market develops, it would also help encourage inter-bank transactions.

Determinants of bank loans

75. **There are two main approaches to analyzing banking sector activity: the production function and the intermediation function.** The first considers the banking sector like any other productive sector and, therefore, is based on estimation of production functions. The underlying assumption is that banks provide financial services based on standard production factors, i.e. labor and capital (Ferrier and Lovell 1990). The second approach is based on the assumption that banks collect resources, such as deposit or bonds, to provide loans (intermediation function). In this case, banks liabilities are inputs and loans are outputs (Kwan et Eisenbeis 1994, Berger et De Young, 1997, and Chaffai, 1997). Consistent with the credit channel approach, we represented bank activity as an intermediation function where loans are one of the outputs and deposits (demand and time deposits) and capital are the inputs.

76. **To adjust their stock of reserves banks have to invest their idle reserves into other assets, such as loans.** They have few alternatives to intermediation as they cannot not invest abroad or in government securities. The determinants of loans are thus the stable part of demand deposits, contractual savings, capital, and involuntary reserves (equation 5).

$$d(L_{i,t}) = \alpha_i + \alpha_t + \alpha_1 d(DD_{i,t}) + \alpha_2 d(Dt_{i,t}) + \alpha_4 d(OCS_{i,t}) + \alpha_3 d(k_{i,t}) + \beta \hat{e}_{i,t-1} + u_{i,t} \qquad (5)$$

Where:

- $L_{i,t}$ is the gross stock of loans;
- $Dt_{i,t}$ are time deposits. They are rather low in the CEMAC and their maturity is rather short (from one month to a year);
- $OCS_{i,t}$ are other contractual saving for the bank i at time t. They represent bank resources different form demand deposits, time deposit, and banks owned funds;
- $\hat{e}_{i,t-1}$ is the involuntary stock of idle reserves computed from equation 1.

77. **The stable part of demand deposits remains the main input for loan production.** Equation 5 is estimated by OLS. Time deposits constitute more stable resources for banks, but their development is not yet sufficient to back a sizable increase in credit. Other contractual savings and banks' own capital however have a significantly larger impact. Finally, a small but significant share of the involuntary idle reserves is transformed into credit.

$$d(L_{i,t}) = \alpha_i + \alpha_t + \underset{(2.39)}{.34}d(DD_{i,t}) + \underset{(3.35)}{.09}d(Dt_{i,t}) + \underset{(4.96)}{.18}d(OCS_{i,t}) + \underset{(3.26)}{.18}d(k_{i,t}) + \underset{(2.14)}{.06}\hat{e}_{i,t-1} + u_{i,t} \quad (6)$$

78. **The simple empirical analysis conducted in the paper allows to draw some interesting lessons regarding banks' behavior in the CEMAC**.

- First, contrary to some popular arguments, banks have a rational use of their reserves. The large stock of idle reserves they have accumulated was mostly for precautionary motives, to cover volatile and extremely short-term deposits. The poor business climate could also explain this behavior, triggering excessively cautious reserve strategies. The banks are also considerably hindered in their cash flow management by regulations (especially capital controls), the dramatic lack of integration of the regional market, and the not-less dramatic underdevelopment of the interbank money market.
- Second, an accumulation of excess reserves beyond the amounts needed for precautionary motives (or progressive improvements in the environment that would decrease the need for precautionary reserves) could indeed trigger a credit boom with associated risks for inflation and banking sector stability. Until now banks have been fairly cautious. In spite of a large demand for credit in the region and excess liquidity, the supply of credit has so far been inelastic. Banks have maintained large precautionary reserves and gave up to the excess liquidity with substantially large

lags[29]. As a result, any incentives that would alleviate these constraints would lead to a lower level of precautionary reserves. It is also possible that the deflationary pressures on bank profits due to large excess liquidity will finally encourage them in the near future to lend more. However, this would be either risky or limited as long as the quality of loans and the quality of the financial information is not seriously enhanced.

E. Conclusions and Policy Recommendations

79. **The paper finds that the credit channel can potentially play an important role in the transmission of monetary policy, but that significant improvements in the macroeconomic and credit environments would be needed for it to operate properly.** The volatile macroeconomic environment and associated volatility of deposits, combined with deficiencies in the legal and judicial environment and information asymetries that increase the risks associated with lending, are leading banks to voluntarily accumulate large amounts of precautionary reserves and limit loan supply. However, a rapid accumulation of involuntary reserves could lead to a credit expansion. In time, greater macroeconomic stability and a more favorable business climate, as well as a deepening of the interbank money market can help reduce deposit variability and precautionary reserves. Loan supply could be enhanced by ensuring that banks are adequately capitalized so that they would be willing to take on more credit risk, and by improving the legal and judicial environment, as well as the information on borrowers.

80. **By controlling banks' liquidity, the BEAC could thus in the future influence credit and inflation in the region, provided a parallel improvement in the credit environment.** More effective liquidity absorption by the BEAC would require an enhanced capacity to forecast liquidity movements (which goes hand-in-hand with better government cash management), more effective use of existing instruments, and the introduction of market-based instruments. An improved analytical understanding of the channels of transmission of monetary policy, as well as of the ultimate impact of monetary policy on macroeconomic variables, would also be essential. The development of a well-functioning interbank market would also support banks' cash flow management and thus reduce the need for precautionary reserves.

81. **BEAC's liquidity management could also help enhance financial intermediation, provided greater reliance on market-based instruments.** The CEMAC Council of Ministers has recently endorsed a plan prepared by the BEAC to phase out statutory advances and introduce government treasury bills. Phasing out statutory advances would have the advantage of eliminating another source of liquidity creation (although for CEMAC countries other than Equatorial Guinea, which does not use advances, and for the CAR, which still

[29] The model gives the size of the adjustment that takes place within one time-period i.e. one year in this case.

relies on central bank financing, the importance of statutory advances has been declining since 2002). The BEAC could also consider introducing marketable central bank bills. Because treasury bills would be country-specific and thus have different risk profiles, these instruments would not be good substitutes, and central bank bills would be more appropriate to conduct regional monetary policy. If the central bank is to issue bills for liquidity management, the maturity of these bills should be strictly different (lower) than the maturity of the bills issued by the treasuries for their cash flow management. The use of market-based instruments would have clear advantages for deepening financial markets, and would eliminate the need for differentiated reserve requirements.

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Appendix

Panel unit root tests for the long-run relationship (equation 1)

Table A.1. Panel Unit Root Tests

ln(Reserves)			
Test	Statistic	p-value	Conclusion
Levels			
Levin, Lin & Chu t*	5.46	1.00	I(1)
Im, Pesaran and Shin W-stat	5.02	1.00	I(1)
ADF - Fisher Chi-square	27.05	1.00	I(1)
PP - Fisher Chi-square	24.46	1.00	I(1)
Differences			
Levin, Lin & Chu t*	-16.73	0.00	I(0)
Im, Pesaran and Shin W-stat	-7.22	0.00	I(0)
ADF - Fisher Chi-square	177.11	0.00	I(0)
PP - Fisher Chi-square	188.59	0.00	I(0)

ln(Demand deposits)			
Test	Statistic	p-value	Conclusion
Levels			
Levin, Lin & Chu t*	4.59	1.00	I(1)
Im, Pesaran and Shin W-stat	5.76	1.00	I(1)
ADF - Fisher Chi-square	37.21	1.00	I(1)
PP - Fisher Chi-square	43.09	0.99	I(1)
Differences			
Levin, Lin & Chu t*	-4.83	0.00	I(0)
Im, Pesaran and Shin W-stat	-0.94	0.17	I(0)
ADF - Fisher Chi-square	79.12	0.05	I(0)
PP - Fisher Chi-square	92.68	0.00	I(0)

ln(Residual)			
Test	Statistic	p-value	Conclusion
Levels			
Levin, Lin & Chu t*	-27.82	0.00	I(0)
Im, Pesaran and Shin W-stat	-6.15	0.00	I(0)
ADF - Fisher Chi-square	151.92	0.00	I(0)
PP - Fisher Chi-square	174.24	0.00	I(0)

Notes:

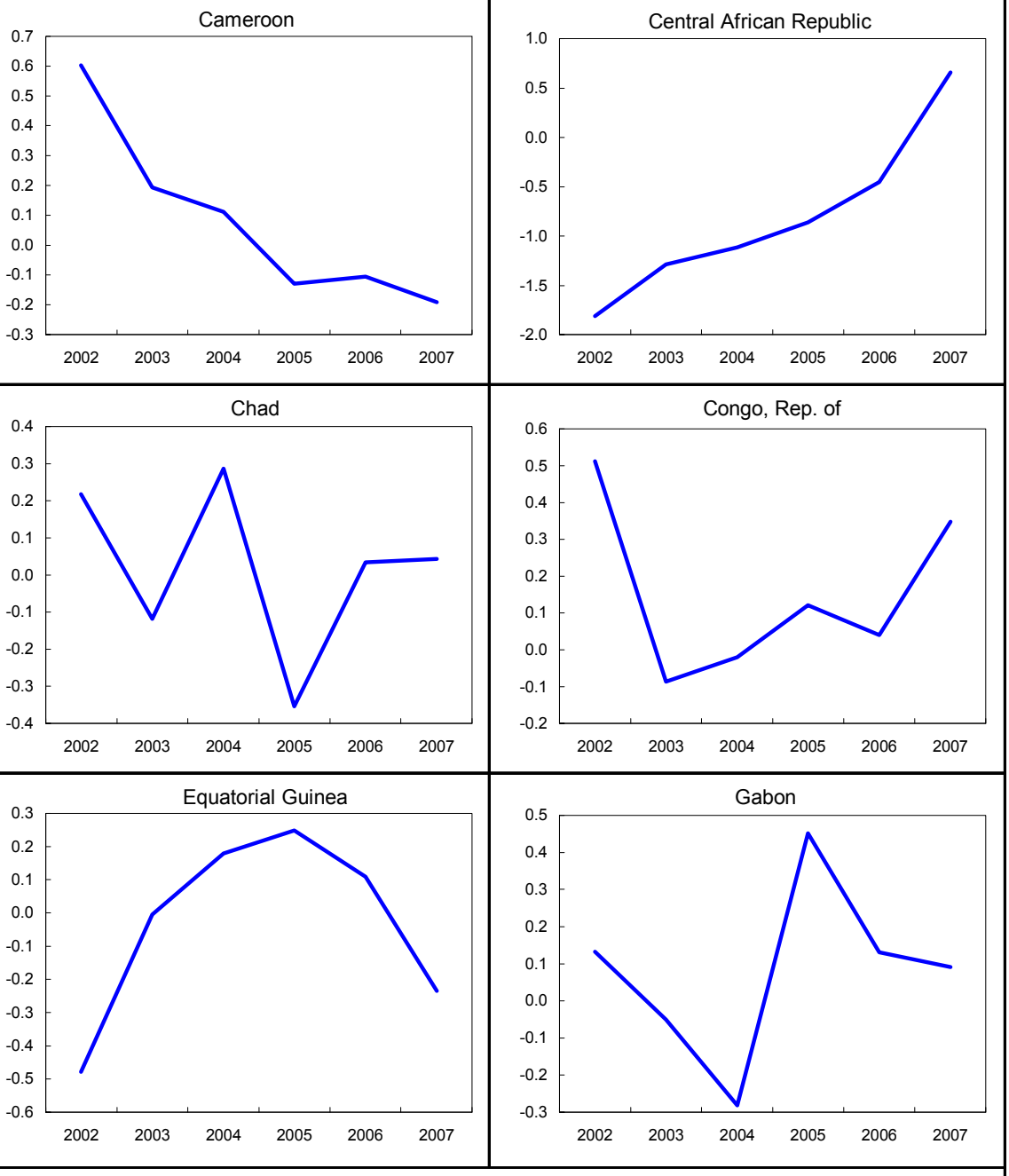
[1] The tests based on the Levin and Lin (1992, 1993) and Levin, Lin and Chu (2002) rho, t-rho and ADF statistics, are based on pooled, within-dimension, estimators and hence consider the parameters of interest as homogeneous across countries. The test based on the Im, Pesaran, and Shin (2003) ADF-t statistic, is based on group mean estimator and treats the parameters of interest as heterogeneous among members.

[2] The tests are one sided and the statistics are normally distributed N(0,1) under the null hypothesis of no cointegration. Under the alternative hypothesis, the statistics diverge to negative infinity (and therefore the left tail is used to reject the null).

[3] One and two asterisks indicate rejection at 10 and 5 percent, or better, respectively.

Country-specific deviations of excess reserves from target

Figure A.1. CEMAC: Country-specific residuals (deviation of excess reserves from target level, as a weighted average of total assets.



Source: BEAC/COBAC; IMF staff calculations.

III. CEMAC: External Stability and Exchange Rate Assessment in an Oil-Dependent Developing Region[30]

A. Introduction

82. **An assessment of external stability in the CEMAC needs to take into account its characteristics as a resource-dependent, developing region.** This implies that the standard CGER methodologies (IMF, 2008), which are used for industrial and emerging economies close to their steady-state, need to be adapted. First, high dependence on oil and the unpredictability of oil prices imply high current account volatility and make temporary shifts difficult to distinguish from permanent changes. Second, with resource depletion, the fundamentals change, and the lasting relationships established on historical trends can not be used as policy guides for the future. Finally, foreign asset accumulation, fueled by oil revenue windfall, can be viewed as both the outcome of balance of payment developments and as a policy tool aimed at addressing the inter-temporal saving-investment constraint.

83. **To address these challenges, this chapter takes a holistic view of external stability.** As no single approach can be expected to produce definitive results, the assessment relies on a combination of the following quantitative and qualitative assessments:

- An analysis of the evolution and sustainability of balance of payments flows and the REER for CEMAC as a whole and for individual countries;
- An econometric assessment of the exchange rate under the standard fundamental equilibrium exchange rate (FEER) approach;
- A forward-looking assessment of exchange rate sustainability under the permanent income hypothesis (PIH) approach adapted to the case of an oil-exporting developing region; and
- An assessment of competitiveness based on external sector outcomes and non-price survey-based indications.

84. **The results of the assessment depend on the time horizon chosen**. Using a backward-looking approach such as the FEER, which assesses whether the REER is currently in line with its fundamentals, suggests no significant misalignment. In particular, the recent real appreciation appears consistent with an adjustment of the equilibrium real exchange rate to permanently higher terms of trade. However, forward-looking methods such as the external sustainability analysis suggest that, in the long run, the external position may not be sustainable. Substantially higher current savings and or investment of oil revenue

[30] Prepared by Corinne Deléchat and Alexei Kireyev.

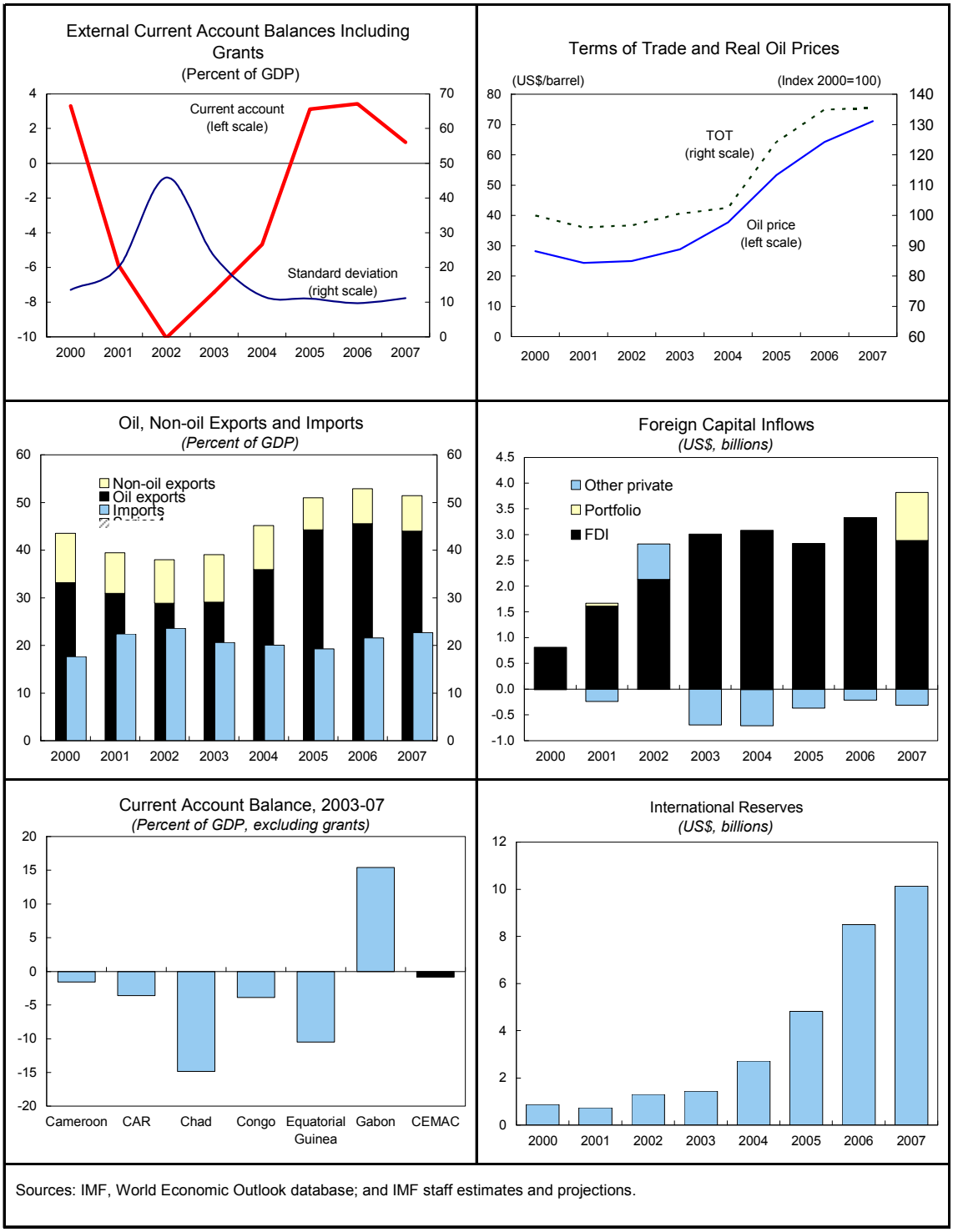
would be needed to maintain external stability beyond the horizon of oil production. A larger share of oil revenue should either be saved in financial assets earning positive real returns or invested in physical assets such as infrastructure that would improve competitiveness and growth in the non-oil sector to sustain imports and consumption in the long run.

B. Balance of Payments Developments and Vulnerabilities

85. **CEMAC's current account volatility and vulnerability to trade shocks is the main risk to external stability.** Current account developments are closely related to oil exports and terms of trade (Figure 3.1). In 1990-2007, the share of oil in GDP tripled from 13 to 39 percent and the share of oil in total exports increased from 59 to 86 percent. Until the recent surge in oil prices, CEMAC ran current account deficits of about 4 percent of GDP. CEMAC's traditionally high general imports exceeded exports, and the trade deficit was financed mainly by official capital flows. Since 2005, the current account turned into a surplus averaging about 4 percent of GDP, fueled exclusively by growing oil prices, while oil production was declining. In 1990-2007, the average annual standard deviation of the current account was 5.1 percent of GDP. It was driven mainly by export volatility, which had a standard deviation of 12.3 percent of GDP around the mean during the same period. In turn, export volatility was caused mainly by the volatility of the terms of trade, whose standard deviation amounted to 17.3 percent of GDP.

86. **The extent of current account vulnerability differs significantly in individual CEMAC member countries.** CEMAC consists of oil-producing countries with different oil production horizons and one non-oil producing country (the Central African Republic). Four countries have relatively short production horizons (Cameroon, Chad, Equatorial Guinea and Gabon), as oil is projected to run out within the next two to three decades, while the Republic of Congo appears to have a longer oil production horizon. There new oil deposits are still being discovered, although oil production is also projected to decline. Volatile oil revenue represents a significant part of all exports receipts, ranging from almost 50 percent in Cameroon to 98 percent in Equatorial Guinea. Different oil production horizons and varying shares of oil in export revenue imply different degrees of current account vulnerability in individual countries. The current account positions are particularly vulnerable in Chad and Equatorial Guinea. These countries are characterized by relatively short oil production horizons and very high dependency on oil revenue. The CAR's current account is also quite vulnerable to shocks, as its export revenues rely heavily on two commodities (diamonds and wood), both with unstable export prices. Petroleum products with volatile prices represent the main single import item.

Figure 3.1. CEMAC: Balance of Payment Developments



Sources: IMF, World Economic Outlook database; and IMF staff estimates and projections.

87. **The capital account does not seem to exhibit any immediate vulnerability.** The stock of FDI liabilities is relatively high (47 percent of GDP) and consists mainly of oil-related investments. The current projections of FDI accumulation point to additional inflows in the range of almost 20 percent of GDP per year on average for Congo, 13 percent in Chad, and 10 percent in both Gabon and Equatorial Guinea. At the same time, projected new FDI in Cameroon—the largest country in the region—and the CAR do not exceed 2-4 percent of GDP per year. Portfolio investments in the CEMAC region are relatively small and have not exceeded on average 1 percent of GDP in 1990-2007. Other investments amount to about 4 percent of GDP and include mainly repayments of official loans, which are made in line with known repayment schedules, while private loans are not significant.

88. **In view of the de facto restrictions on capital mobility, private investments do not pose a substantial risk of abrupt outflows**. The capital account is far from fully open. Without the central bank's authorization, residents are not supposed to hold accounts abroad or make additional transfers to authorized accounts. Residents need to report their lending and borrowing transactions with nonresidents. Domestic borrowing or lending by nonresidents, as well as inward and outward FDI exceeding CFA 100 million, should be reported in advance to the Central Bank. And the issuance, advertising and sale of foreign securities within CEMAC for amounts exceeding CFAF 10 million are subject to prior authorization.

89. **The overall debt situation of the region seems manageable.** Cameroon is a post-debt relief country with a low level of external liabilities (Table 3.1). In CAR, Chad, and Congo the overall debt levels do not substantially exceed the relevant sustainability benchmarks. Equatorial Guinea has virtually no external debt, while Gabon's external debt liabilities are sustainable and projected to decline.

Table 3.1. CEMAC: Debt Position, 2007

(Percent of GDP)

	Weight in CEMAC [1]	Threshold	External debt NPV	External debt Nominal	HIPC status	LIC status	CPIA index
Cameroon	36	40	4	6	post-HIPC	yes	weak
CAR	3	30	44	47	Interim	yes	weak
Chad	15	30	17	24	Interim	yes	weak
Congo	12	30	36	86	Interim	yes	weak
Equatorial Guinea	14	n/a	n/a	1	n/a	no	n/a
Gabon	19	n/a	n/a	27	n/a	no	n/a

[1] In percent of PPP-adjusted GDP.

90. **Reserve coverage is comfortable.** The current reserve coverage at about 5 months of imports seems adequate to cover current account and FDI shocks. In addition, the unlimited credit line provided by the French Treasury, although not considered part of reserves, can, in

principle, perform a similar function. Although such a level of reserve coverage exceeds the conventional norms, it is appropriate for the CEMAC region, which is vulnerable to large terms of trade fluctuations. The adequate stock of liquid reserves, combined with the credit line, limits the risk of forced parity adjustment in the case of a substantial shock.[31]

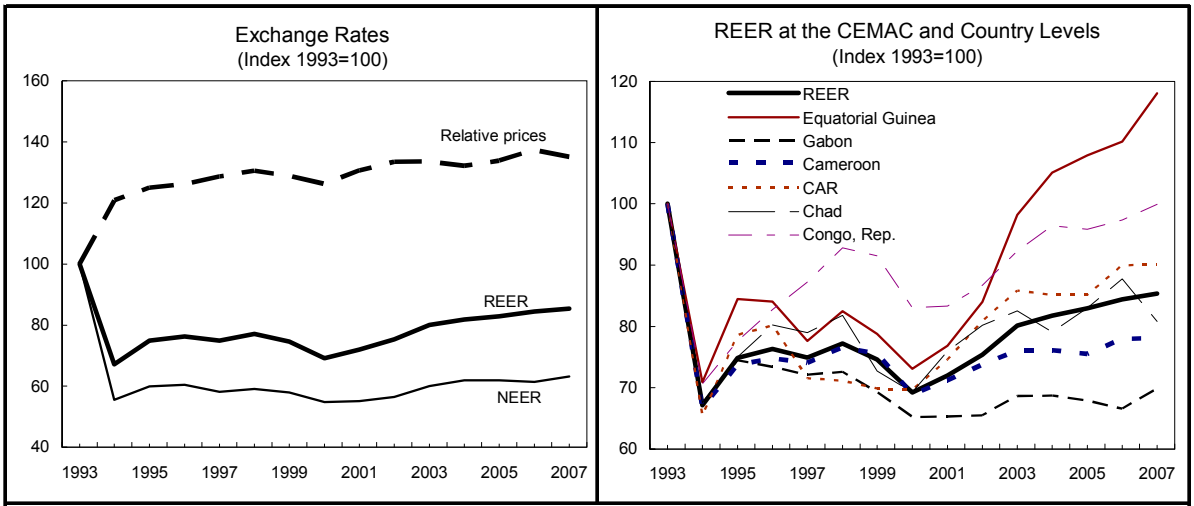
C. REER Developments

91. **Three distinct episodes can be identified in the evolution of the CPI-based REER in the post-1994 devaluation period**: (i) in 1994-98 the real effective exchange rate appreciated by over 50 percent because of the increase in wages and domestic prices after the devaluation; (ii) in 1999-2000, it depreciated owing mainly to the deterioration in terms of trade; (iii) from 2001 until now the REER has gradually appreciated, driven mainly by the strengthening of the Euro against the U.S. dollar and the continuing increase in oil prices.

92. **REER appreciation has been persistent, but so far modest, and does not seem to pose a risk to external stability** . Reflecting the continued strength of the Euro, the REER appreciated by 2 percent in 2007. The REER now stands at 86 percent of its pre-1994 devaluation level (Figure 3.2). Consumer price inflation—after a temporary increase to 4.2 percent in 2006—moderated to 0.8 percent in 2007, reflecting mostly one-time factors, such as food price developments in Chad and a partial pass-through of higher oil prices in several countries of the region. However, food price inflation appears to have accelerated in 2008, which may have led to further REER appreciation.

[31] For a detailed assessment of reserve coverage and reserve management please see: SM/08/___, The CFA Franc Zone: Common Currency, Uncommon Challenges (2008), Gulde, Anne Marie, Tsangarides, Charalambos Editors, and SM/05/198, June 3, 2005.

Figure 3.2. CEMAC: Real Exchange Rates Developments



Sources: World Bank, Doing Business 2006; UN COMTRADE database; IMF, Direction of Trade; World Economic Outlook database; and IMF staff estimates and projections.

93. **Modest overall REER appreciation masks significant differences among member countries**. Driven mainly by inflation differentials, the REER of individual countries has fluctuated within wide margins around the CEMAC average. Since 2000, the REER appreciation in Equatorial Guinea has been the highest, reaching 62 percent, whereas in Gabon it has not exceeded 7 percent, compared with the 23 average for CEMAC as a whole.

D. Fundamental Equilibrium Exchange Rate Analysis

94. **This section assesses the CEMAC REER using the Fundamental Equilibrium Exchange Rate (FEER) approach, one of the proposed CGER methodologies** (IMF, 2008). It updates the FEER analysis based on the Edwards (1989) method prepared for the 2007 Article IV consultation (see SM/07/211) and extends it along the lines of the recent background study for WAEMU countries (SM/08/137). To be comparable with last year's analysis, the assessment is first conducted estimating Edward's model using CEMAC aggregated data and estimating the model using Johansen's (1995) cointegration methodology, and then, as a robustness check, the model is estimated using panel data for invidual CEMAC countries, using for the first time Pedroni's (1996, 2000) FMOLS estimator.[32]

[32] The description of the model and estimation methodology draws on the similar analysis prepared for WAEMU countries in SM/08/137 and on the joint AFR-PDR note on "Assessing Real Exchange Rates in Low-Income Countries", forthcoming. Equatorial Guinea is not included in the analysis, due to the lack of availability of a full time series for 1969-2007. Although the estimated model is the same as in SM/07/211, a data revision between the two studies has involved a substantial update of the PPP-based GDP weights for the CEMAC countries.

95. Results indicate that as of end-2007 the REER remains broadly in line with fundamentals, although differences between results from the two estimation methods could be consistent with some degree of overvaluation. Using CEMAC's aggregated data, estimation results show no significant misalignment as of end-2007 (less than 1 percent), and are roughly consistent with last year's. Using the coefficients from the panel FMOLS method, however, indicates some degree of overvaluation (of about 23 percent). However, the cointegration tests in the panel case are far from conclusive which casts doubt on the results. In addition, in the panel estimation the large improvement in the region's terms of trade since 2000 does not appear to have a significant impact on the equilibrium exchange rate, and the coefficient has the wrong sign.

Model description

96. **Edwards' (1989) model of a three-good (exportables, importables and nontradables) small open economy with a fixed exchange rate provides a coherent framework for identifying the fundamental variables that are associated with the EREER**.[33] The equilibrium exchange rate is defined as the exchange rate that results when internal and external equilibrium are attained simultaneously in the economy. Internal equilibrium is achieved when the market for non-tradable goods clears in the present and is expected to clear in the future as price and wage flexibility ensure that the condition of internal balance (demand equal to supply) is satisfied. External equilibrium is achieved when the current account balance is "sustainable", given a sustainable level of capital flows. Since only the fundamentals can influence the EREER, the model can be used to describe misalignments by separating the factors that affect the equilibrium real exchange rate from factors that lead to deviations from equilibrium.

Empirical specification and variables

97. As in SM/07/211, we use the Edwards' model to identify the dynamics between the fundamentals and the REER after augmenting it to capture the Balassa-Samuelson effect. The empirical model we estimate is:

$$\ln(\text{REER}) = \alpha_0 + \alpha_1 \ln(\text{TOT}) + \alpha_2 \ln(\text{CGR}) + \alpha_3 \ln(\text{INV}) + \alpha_4 \ln(\text{PROD}) + \alpha_5 \ln(\text{OPEN}) + \varepsilon_t$$

where ln denotes the natural logarithm, ε_t is an error term and

REER = Real effective exchange rate;[34]
TOT = Terms of trade of goods;

[33] The model is discussed in detail in Edwards (1989) and Williamson (1994). Cerra and Saxena (2002), and Mathisen (2003), Goh and Kim (2006), and Abdih and Tsangarides (2006) are applications of Edwards' FEER methodology.

[34] Following the IMF convention, an increase in the REER is defined as an appreciation.

CGR = Government consumption as a share of GDP;
INV = Investment as a share of GDP;
PROD = Technological progress index; and
OPEN = Openness.

98. The dataset consists of a panel of annual observations covering 1969–2007 for all CEMAC member countries (except Equatorial Guinea). Definitions and sources of variables are in the appendix. Variable plots are in Appendix Figure A.1. The long-run determinants for the EREER are defined by the following fundamentals:

- **Terms of trade.** The expected sign is positive: a positive terms of trade shock induces an increase in domestic demand through the wealth effect, hence an increase in the relative price of nontradable goods, which leads to an REER appreciation.

- **Government consumption** (as a share of GDP). The expected sign is ambiguous, depending on the share of tradable in government consumption. If government spends relatively more on non-tradable goods, an increase in consumption should lead to an REER appreciation.

- **Degree of trade controls/restrictions**. The expected sign is positive: the more trade controls, the higher the domestic prices, leading the REER to appreciate. This variable is often proxied by trade openness, the sum of exports and imports as a share of GDP.

- **Technological progress/productivity** (capturing the Balassa-Samuelson effect). The expected sign is positive: an increase in relative productivity in the tradable goods sector raises relative wages, leading to an REER appreciation. This variable is often proxied by real per capita GDP relative to main trading-partner countries.

- **Investment** (total investment relative to GDP). The expected sign is negative: a rise in investment—assuming a high import content, likely in LICs—would lead to an REER depreciation.

99. In the CEMAC region, we observe a volatile pattern of terms of trade, with a large increase since the late 1990s as a result of increases in oil prices; openness has exhibited a consistent increase since the late 1980s; while productivity has persistently declined relative to trading partners (i.e., real GDP per capita with respect to trading partners) since the mid-1970s; government investment and government consmption have also been quite volatile, with investment tending to increase since the 1990s and government consumption to decline.

Estimation methodology

100. As a robustness check, the model is estimated using the Johansen (1988, 1991, and 1995) vector error correction approach on CEMAC aggregated data as well as the Pedroni

(1996, 2000) mean group fully modified ordinary least squares (FMOLS) approach on panel data for individual CEMAC countries.[35] Key advantages of panel methods over single time series methods is that they allow for greater precision, are robust to endogeneity, as well as to many forms of omitted variables, measurement error and simultaneity. Because CEMAC countries conduct their national economic policies within the framework of macroeconomic convergence criteria they should *a priori* be sufficiently homogeneous to justify the use of panel techniques.[36] In the Johansen single time-series estimates, the structural break introduced by the 1994 devaluation is acknowledged by the inclusion of an exogenous (and thus not part of the cointegration relationship) impulse dummy variable for the year 1994. The FMOLS method does not allow for the introduction of exogenous variables.

101. Both approaches require that all variables be non-stationary in levels, and that they be cointegrated. Individual time-series and panel unit root and cointegration tests are in Appendix Tables 1 and 2. As can be seen from Appendix Table 2, the cointegration result for the panel data is very weak. An absence of cointegration would mean that the results derived from the panel estimation are not valid (see below). After having estimated the Edwards model, we construct the equilibrium real effective exchange rate under each econometric approach. This demands a decomposition of the fundamentals into their permanent and transitory components. The permanent component of the fundamentals is interpreted as the equilibrium value of the fundamentals, whereas the transitory component measures temporary fluctuations. The EREER is then constructed as a function of the estimated coefficients and of the equilibrium components of the fundamentals. There are several alternative methods for identifying the permanent components of the fundamentals. As in SM/07/211, we apply the Hodrick-Prescott (HP) (1997) filter.

Empirical results

102. The results are broadly consistent with the predictions from economic theory and with earlier analysis, but a comparison of the three sets of estimates suggests only moderate stability and robustness. The estimated elasticities of the cointegrating relation for the two different econometric approaches together with their t-statistics (in brackets) are presented in Text Table 1, and are compared to the results obtained in SM/07/211. However, although the estimated model is the same as in SM/07/211, a data revision between the two studies has involved a substantial update of the PPP-based GDP weights for the CEMAC countries,

[35] Our approach is similar to those of Egert (2003) and Egert and Lommatzsch (2004), who investigate the EREERs of Central and Eastern Europe accession countries. See also Chudik and Mongardini (2006) for an application to modeling EREERs in Africa, and Roudet, Saxegaard and Tsangarides (2007) for an earlier application to the WAEMU.

[36] See SM/07/119 by Roudet, Saxegaard and Tsangarides (2007) for details of the estimation methodology.

which explains the relatively large difference in coefficient estimates from one year to the other.[37]

(i) the positive long-term impact of *technological progress* (proxied by the relative real GDP per capita) confirms the Balassa-Samuelson effect, and this effect is quite robust across the three sets of estimates;

(ii) using aggregate data the *terms of trade* are as expected positively correlated with the REER, but in the panel version the coefficient on terms of trade is not significant and is negative;

(iii) *openness* has the expected negative and significant impact on the REER and, together with productivity is the most robust result across the three sets of estimates;

(iv) *government consumption* has an ambiguous impact on the REER, with a positive coefficient in the 2007 and the panel estimation (though in the latter case it is not significant) suggesting that most government spending is directed towards nontradables, but it has a negative and significant impact in the 2008 estimates with aggregate data; and

(v) *investment* in the 2008 estimation with aggregate data is negatively correlated with the REER confirming the hypothesis that investment moves spending towards traded goods, but is insignificant and negative in the other two sets of estimates.

103. The error correction term (the coefficient on the first difference of the REER in the short-run equation) is negative and significantly different from zero, indicating that the REER follows a stable mean-reverting process. This coefficient estimate is consistent between the 2007 and 2008 estimation of the aggregate model and suggests that the half-life of the deviation is about 3.5 years on average, which is also close to that found in the case of the latest estimation of the WAEMU equilibrium exchange rate (SM/08/137).

[37] An intermediary update of the FEER analysis using the same equation conducted in November 2007, that used the same historical data as in SM/07/211, adding 2007 projections did indeed yield results that were, unsurprisingly, more consistent with those in last year's staff report, showing a statistically insignificant 5 percent overvaluation.

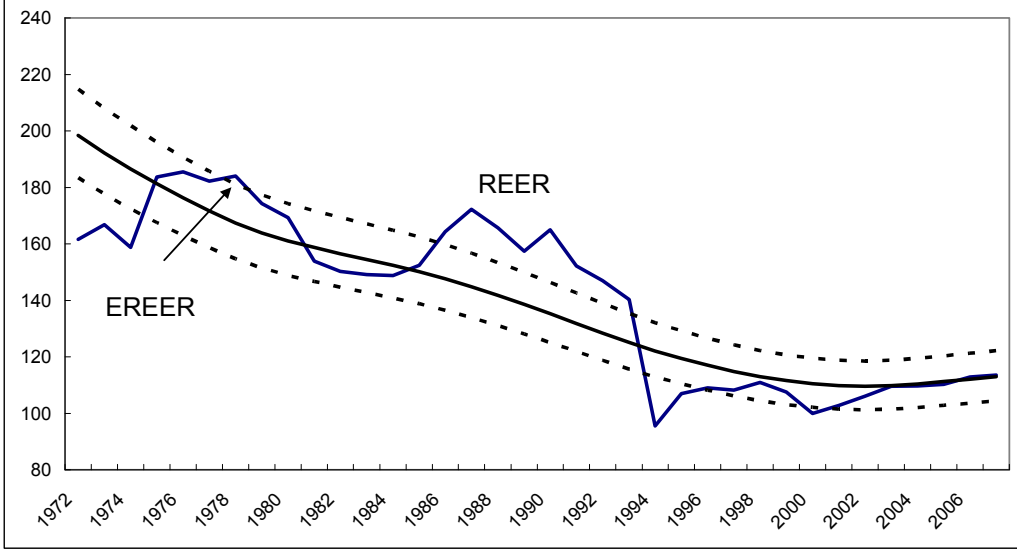
Text Table 3.1. CEMAC: Results of Cointegration Estimation

	Johansen single time series		Panel (FMOLS)
Long-Run Coefficients Estimates[1]	SM/07/211	2008 Update	
Ln (Productivity)	0.32 ***	0.64 ***	0.79 ***
	[8.13]	[6.98]	[9.04]
Ln (Terms of trade)	0.35 ***	0.63 ***	-0.05
	[3.48]	[5.14]	[-0.86]
Ln (Openness)	-0.30 ***	-0.80 ***	-0.31 ***
	[-2.48]	[-4.59]	[-4.82]
Ln (Government consumption)	0.33 **	-0.59 ***	0.01
	[2.18]	[-3.30]	[[0.61]
Ln (Investment)	0.07	-0.74 ***	0.03
	[0.56]	[-3.56]	[-0.21]
Constant	3.30	8.56	N. A.
Error-Correction Term Estimates			
D [ln (Real effective exchange rate)]	-0.22 ***	-0.18 ***	N.A.
	[-3.24]	[-3.80]	
Half-life of deviation[2]	3.0	3.9	

Notes:
1. Three, two and one asterisks indicate significance at the 1, 5 and 10 percent levels, respectively. T-Statistics in brackets.
2. The speeds of adjustment are calculated from the error correction coefficient.

104. Under both approaches, equilibrium REERs (EREERs) were computed using the estimated long term parameters in Table 1.1 and the permanent components of the fundamentals derived using the Hodrick-Prescott decomposition (Figure 1.3). Results indicate that the CEMAC REER went through a period of overvaluation prior to the 1994 devaluation, suggesting that the 1994 CFA devaluation was warranted. After the devaluation the gap between the actual REER and its equilibrium level narrowed steadily as the REER and EREER moved in opposite directions. The time series methods suggest that the CEMAC REER reached its equilibrium level by 2003, and that by end-2007 the exchange rate exceeded its equilibrium level by about ½ percent. This is broadly consistent with the result in SM/07/211, where a relatively small (about 6 percent) and insignificant overvaluation was found as of end-2006. In contrast, the panel method suggest that the REER last reached its equilibrium level in 2000, and that the exchange rate at end-2007 exceeded its equilibrium level by about 23 percent.

Figure 3.3. CEMAC: Equilibrium Exchange Rate (Johansen Single Time-Series Estimation)



Sources: BEAC, IFS, IMF staff calculations

105. The difference between the two sets of results can be explained by the different impacts of the fundamentals, in particular the terms of trade. In the single time series estimation the terms of trade effect is positive and significant, and the large improvement in this variable since 2000 due to the oil price increase explains that the EREER under this specification did appreciate since 2000. In the panel specification, the coefficient on terms of trade is insignificant and negative, and the results are driven by the strong positive impact of the (declining) relative productivity and the negative impact of (increasing) openness, explaining that the EREER would tend to depreciate more than in the previous case. This surprising result casts some doubt on the robustness and the reliability of the CEMAC panel estimates, as compared for example with the ones obtained for the WAEMU. The fact that the panel cointegration test provides very little evidence in support of cointegration would suggest that there is no long-run relationship between the fundamentals and the REER. One possible explanation is that CEMAC countries exhibit too much heterogeneity and do not form a valid panel. Given the limited stability and robustness of the results, another explanation is poor data quality, combined with the large impact of the revision of PPP weights for the GDP of the countries in the region between the 2007 and 2008 consultations.

E. Consumption-Smoothing Approach to Exchange Rate Assessment

106. **In this section, the external sustainability approach as proposed by the Consultative Group of Exchange Rate issues (CGER) is modified to take into account the exhaustibility of oil resources.** Since exchange rate fundamentals shift during the development process, an assessment has to be based predominantly on a forward-looking

method, such as the external sustainability approach, which is more appropriate for developing countries. The external sustainability approach is adapted to the case of oil exporters in the sense that the benchmark net external asset position and the associated current account norm are constructed as the sustainable path of asset accumulation and current account trajectory consistent with the permanent income hypothesis.

107. **Two related versions of an approach to exchange rate assessment based on the permanent income hypothesis (PIH) are presented here.** The first version addresses the following question: what path of reserve accumulation during the period of oil production is needed to preserve exchange rate sustainability in the long run? Another way to look at this issue is to ask at what level should the non-oil current account deficit be maintained in the long run to avoid disruptive movements in the exchange rate. Although focusing on different measures of external stability, these two versions are essentially equivalent.[38]

108. **The sustainability of the current account and the exchange rate depends on the ability of producers of exhaustible natural resources to smooth consumption over time.** Given the inevitable fall in income, derived mainly from the exhausting supply of non-renewable resources, the exchange rate may be assumed to be in long-run equilibrium only if the economy is accumulating sufficient financial and physical assets to smooth future consumption. Therefore, exchange rate sustainability requires the current account to register surpluses during the period of extraction of the natural resource to finance accumulation of financial or physical assets needed to generate income to allow unchanged consumption in the post-oil era. [39]

109. **The rest of the section is structured as follows.** We first discuss the underlying current account, which is used in both versions of the consumption smoothing approach. We then apply the flow and stock versions of the approach to CEMAC. Implications for the exchange rate are discussed in the conclusion.

The underlying current account balance

110. **Both versions require that the CA norm be calculated based on the PIH to be compared with the underlying CA account projected to prevail in the medium term.** To evaluate the underlying CA, temporary factors need to be excluded. For the CEMAC region, "temporary factors" were defined as factors that affected the balance of payments in the past three years but are now expected to unwind automatically, in an orderly way, and without changes in policies in 2008–2013, i.e. by the end of the standard medium-term projection

[38] Variations of this approach have been used in SIPs on Algeria (SM/08/15), Botswana (SM/07/375), and Gabon (SM/08/233), and Clausen (2008).

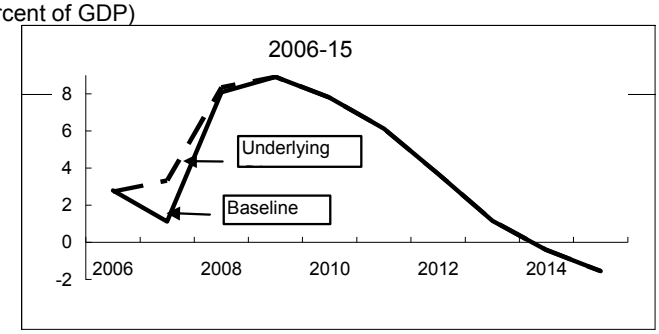
[39] In the case of developing countries the strict version of the PIH, which aims mainly at smoothing future consumption through accumulation of financial assets, must be modified to take into account the fact that these countries have large needs for physical and social infrastructure and should thus also invest some of the resource windfall into productive assets in order to raise future non-resource based GDP growth.

period. Oil and food price increases have been treated as permanent factors affecting all countries in the region, whereas the temporary factors have been identified on a country-by-country basis.

Table 3.2. Baseline and underlying current accounts

(Percent of GDP)

	2007		
	Baseline	Underlying	Diff.
Cameroon	0.4	0.4	0.0
CAR	-4.5	-4.5	0.0
Chad	1.0	1.0	0.0
Congo	-19.3	2.0	21.3
Equatorial Guinea	3.9	0.3	-3.6
Gabon	14.8	15.3	0.5
CEMAC	1.2	3.3	2.1



111. **In most CEMAC countries the deviation between the projected and the underlying current account (UCA) is not significant**. The one major difference is explained by a serious accident on one of the oil drilling plants in the Republic of Congo, which halted production and resulted in a 17 percent decline in oil output by year-end (Table 3.2). Correspondingly, oil exports declined, while imports of machinery and services to repair the damage increased. The resulting 2007 current account deficit for Congo was temporary and is projected to turn into surplus in 2008, although somewhat lower than in the baseline. Other factors may have potentially temporary but lumpy effects on the balance of payments of the region. They include the Equatorial Guinea's $3 billion LNG plant and several infrastructure projects, such as building roads, mostly with imported material . In addition, the next African soccer cup in 2010 will be held in Equatorial Guinea, and will certainly involve further infrastructure projects. Equatorial Guinea also purchased Devon's share of its oil fields in 2008, for a value of $2.2 billion to be paid in three equal installments over 2008-2010. This major purchase will have immediate effect on the financial account in BOP and might also involve further investment in the oil fields by Equatorial Guinea in the coming years.

112. **The treatment of oil exports and oil-related imports presents a particular challenge**. On one hand, there is a strong case to consider such flows as temporary, as the analysis assumes that CEMAC countries will run out of oil in the foreseeable future and therefore there will be no need to import equipment to extract oil and maintain oil fields. Under this assumption, the underlying CA and the derived CA norm should be lower as CEMAC. On the other hand, oil-related inflows have allowed countries to enhance current consumption, reduce poverty and repay some debts, although the overall living standards remains low. To preserve the achieved consumption level and build on it, CEMAC should be capable of maintaining during the post-oil era nonoil CA sustainable deficits comparable in magnitude with the existing nonoil deficits but financed from the revenue on the assets accumulated during the remaining years of oil production. Such accumulation calls for substantial upfront savings and the treatment of oil exports and oil-related imports as a

permanent phenomenon for the remaining period of oil production. The latter approach is taken in this paper.

Flow version

113. **In the dynamic version, the CA norm can be defined analogously to the definition of the sustainable fiscal balance**. There are several methods to calculate a sustainable fiscal balance in a resource-producing region. One method defines the sustainable overall fiscal balance as a difference between total revenue and permanent income (IMF, 2003). This suggests that to preserve fiscal sustainability in the long run a government should spend only the permanent portion if its revenue. Similarly, external stability implies that a country as a whole spends only the permanent portion of its income generated by net exports. Exports generate income from oil and nonoil flows, and their permanent component consists of nonoil revenue and the annuity from oil-financed savings. In most CEMAC countries 30-40 percent of oil revenue from exports accrue to the governments and 60-70 percent to foreign oil companies, and nonoil revenues go mainly to the private sector. Assuming that in equilibrium the saving-investment balance of the private sector is zero, the CA norm can be estimated as a difference between oil export revenue and the annuity.

114. **The dynamic version of the consumption-smoothing approach consists of four essential steps**: (i) estimate the NPV of oil wealth based on projected oil revenue; (ii) calculate the annuity on oil wealth; (iii) obtain the CA norm as a difference between oil revenue and the annuity; (iv) derive implications for the exchange rate.

Table 3.3. CEMAC: Assumptions (percent)

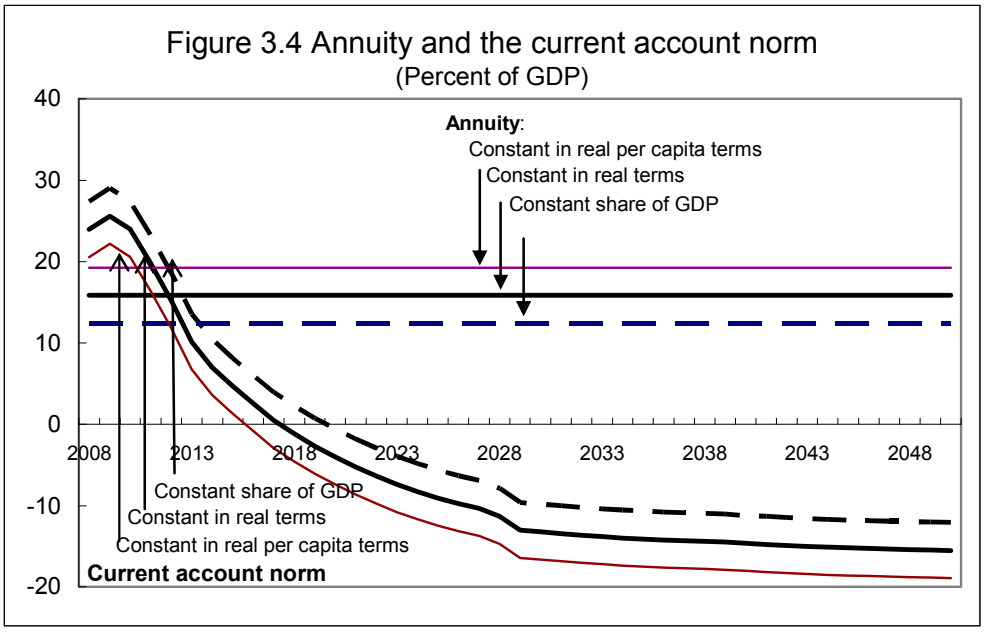
	Baseline	Alternative
Real GDP growth	4.5	4.5
Inflation	3.0	3.0
Discount rate	7.1	6.1
Real rate of return	4.0	3.0

115. **The present discounted value of oil wealth depends on a number of assumptions**. The projections are based on oil prices set at the June 2008 WEO baseline with country-specific adjustments. Oil production horizons are based on the end 2006 proven reserves and the 2005-07 average extraction rates as reported by country teams. Consistent with other PIH-based assessments, the real rate of return is set at 4 percent, which translates into a 7.1 percent nominal rate used to discount oil revenue under the baseline. In the alternative scenario the real rate of return is assumed to be less favorable (Table 3.3). It is also assumed that current monetary reserves of about 5 months of imports are adequate to cover plausible balance of payments shocks and will remain unchanged as a share of GDP. The accumulation of long-term investments financed by oil revenue is assumed to start in 2008.

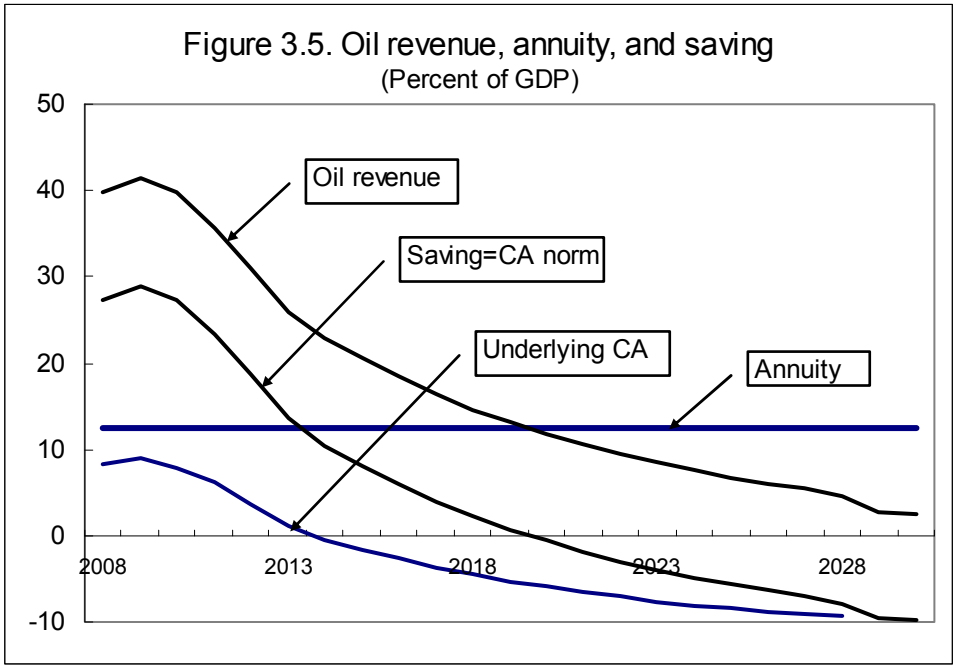
116. **The calculation of the annuity is a critical part of the analysis**. The annuity in this case refers to an implied stream of fixed payments over a specified period of time. It is used to compute the permanent part of oil revenue by transforming the projected stream of oil revenues into a hypothetical annuity with the same present value. Therefore, the calculation is done in three steps (i) calculate present value of oil revenue under the assumption of a

certain discount rate for each year and for the projected period as a whole; (ii) set the total present value of oil revenue equal to the total present value of the hypothetical annuity; (iii) express the total annuity relative to a certain denominator.

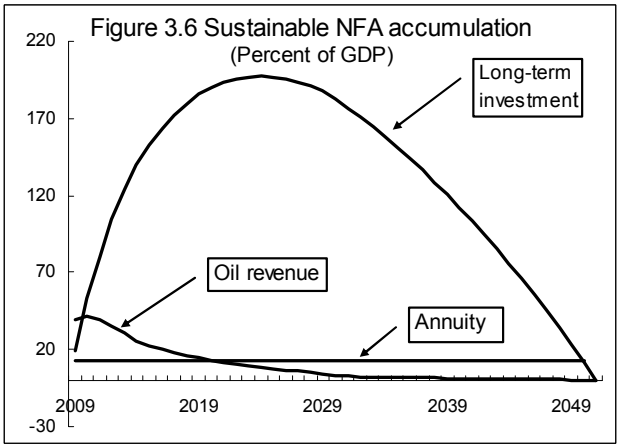
117. **The annuity on oil wealth can be calculated in several ways**. One is to calculate an annuity that is a constant as a share of GDP or nonoil GDP. This method seems appealing because the presentation of results as shares of GDP, which make them immediately comparable with the authorities' fiscal programming and can facilitate the communication of the policy message. Also, calculations in terms of GDP ensures that savings are significant while oil revenue are still high. However, targeting a constant level as a percent of GDP may be less appropriate for developing countries, where the target should explicitly acknowledge their objective to increase growth rates. As their nonoil GDP should be expected to grow significantly, growth would mean greater real spending out of oil wealth in the future. Therefore, a more appropriate target for developing countries might be constant expenditures in real terms, or constant real per capita expenditures. Either would call for less savings up front (Figure 3.4). Depending on the approach used, the annuity was found to be 12-19 percent of GDP.



118. **The current account norm is derived as a difference between oil revenue and the annuity.** The norm suggests that, to produce sufficient savings to allow consumption to be smoothed over time, CEMAC needs far more substantial CA surpluses in the next few years of oil production. (Figure 3.5). These surpluses should be significantly higher than the projected CA surpluses based on the current policies of spending most of oil revenue.



119. **Based on this metric, CEMAC's external position is not sustainable in the long run**. The projected current account surpluses are not sufficient for the accumulation of oil-financed reserves needed to smooth consumption in the long run, as the underlying CA is substantially lower than the CA norm. Such a divergence between the underlying CA and the CA norm would imply substantial overvaluation of the exchange rate, if the exchange rate is viewed as the only instrument available to the authorities to correct the misalignment, which is implausible in this case.



120. **However, saving the difference between oil export revenue and the annuity could contribute to exchange rate sustainability in the long run.** The PIH establishes a reference path for the accumulation of long-term investment, which is consistent with the CA norm and, therefore, with exchange rate sustainability (Figure 3.6). By spending only the annuity and investing the difference between oil revenue and the annuity at a positive real interest rate, CEMAC countries should be able to accumulate sufficient assets during the remaining years of oil production so as to preserve a permanent revenue stream in the post oil period.

1. **The current rate of saving is not sufficient to preserve external stability**. CEMAC's current stock of savings amounts to approximately 17 percent of GDP and is

represented mainly by liquid monetary reserves of the BEAC. With the current high oil prices, the level of reserves in this broad definition are projected to increase by 3.7 times in 2007-13, or almost double in terms of growing GDP, and would include a portion of monetary reserves and long-term investments. However, this saving rate is not sufficient. To preserve the achieved level of imports and consumption in the long run, CEMAC should save and invest the difference between its projected oil revenue and the implied annuity.

121. **The magnitude of saving required to preserve external stability depends on a number of parameters**. First, depending on the selected target (a constant share of GDP, constant real expenditure or constant real per capita expenditure), the annuity varies from 12-19 percent of GDP. Therefore CEMAC countries should save between 17 and 25 percent of GDP out of oil revenue, i.e. about 1/2 to 2/3 of its current oil revenue. Second, some CEMAC governments already accumulated certain savings abroad by not repatriating part of their oil revenue. The exact magnitude of these savings is not known but should be included in the calculations as a starting point, which may also translate into a lower path for sustainable asset accumulation. Third, some countries (e.g., Equatorial Guinea) have a significant private oil sector, which saves and productively invests substantial amounts of oil revenue. These private investments amount to about 3 percent of CEMAC's GDP, which should be also counted as part of the savings to preserve external stability. Fourth, returns on domestic investments may differ substantially from the baseline assumptions. Higher returns, in particular on productive domestic investment in physical infrastructure, would lower the needed saving rate, whereas lower returns would increase it. Finally, the projections are very sensitive to assumptions on oil prices. A 10 percent decline in oil prices compared to the WEO baseline would decrease the annuity by 1.2 percentage points and would also point to the need to save more to preserve exchange rate sustainability in the long run.

Stock version

122. **Instead of focusing on the sustainable overall current account path, the static version of the consumption smoothing approach looks at the sustainable nonoil CA balance**. This version of the approach broadly follows Akram (2004) and Thomas, et al. (2008), which use an oil stock to estimate the equilibrium non-oil CA consistent with optimal consumption smoothing. This version calculates the non-oil CA deficit that can be permanently financed by revenue generated by oil and nonoil wealth. If the calculated non-oil CA norm projected to prevail in the medium term differs from the existing underlying CA, the exchange rate may need to be adjusted to close the gap.

123. **The static version of the consumption-smoothing approach also consists of four essential steps**: (i) estimate the NPV of oil wealth based on the proven stock of oil reserves; (ii) calculate the annual return on the oil and non-oil wealth; (iii) derive the norm for the nonoil CA, which can be sustainably financed by the annual returns on the overall wealth in the long run; (iv) derive implications for the exchange rate.

124. **The first step is to derive the net present value of oil wealth.** This can be done based on data on the volumes of oil reserves (Table 3.4). CEMAC oil reserves are known from geological surveys and their annual oil production is published in national and international statistics. The extraction rate can proxy the duration over which CEMAC countries will be able to maintain current account surpluses. To obtain the current extraction rate, average 2005-2007 production was expressed in terms of the oil reserve stock at end-2007. Chad and Equatorial Guinea have the highest extraction rates, as they draw 8-9 percent of their oil reserve sock a year; Gabon has the lowest rate of 4 percent. For the calculation of the net present value of oil reserves the CEMAC the median of 6 percent was used, which implies that CEMAC, as an oil producing region, would run out of oil in17 years.

Table 3.4. Oil reserves, production and extraction

	Oil reserves 2007 (million barrels)	Production Avg. 2005-07	Extraction rate (percent)
Cameroon	516	31.1	6.0
Chad	668	57.3	8.6
Congo	1,599	91.0	5.7
Equatorial Guinea	1,580	128.4	8.1
Gabon	2,093	90.9	4.3
Median	6,456		6.0

125. **The present value of future oil production was derived by discounting the overall proven oil reserves**. Consistent with the dynamic approach, the calculations assume a 4 percent real discount rate, the 17 year average oil extraction horizon, the oil price of US$ 92, which is the weighted average of country-specific projections for 2008-2027. The NPV of oil wealth calculated amounts to CFAF 109 trillion (US$ 250 billion). The annual return on this wealth at a 4 percent real discount rate is exactly 10 percent in terms of GDP.

126. **The second step is to calculate the components of the nonoil current account norm.** It can be shown (Thomas, et al, 2008) that at equilibrium, the CA norm consists of four components—the return to oil wealth, the present discounted value of the change in non-oil cash flow, the consumption tilting factor (i.e., saving or dissaving beyond consumption smoothing), and a correction for domestic consumption. By construction, the return on oil wealth is the present discounted value of future oil production calculated above. Since the non-oil cash flow defined as non-oil GDP net of investment, government consumption and external transfer and the consumption tilting factor are quite small in the CEMAC, they were assumed equal to zero. Domestic consumption of oil wealth is not significant in relative terms. Absent the data on other CEMAC economies, domestic consumption of oil wealth was approximated by the difference between production and exports in Cameroon. Finally, the components of the non-oil CA were expressed in terms of the 2013 CEMAC's GDP, a weighted average GDP for individual countries.

127. **The third step is to compare the CA norm with the actual underlying CA and infer implications for the exchange rate.** Aggregating CA components suggests that in

equilibrium, CEMAC can afford running a non-oil current account deficit in the order of 13 percent of GDP. This assumes the objective of constant expenditure financed by oil wealth, when the alternative targets, as discussed above, might be constant real per capita expenditure or a constant share of GDP (Table 3.5). This CA norm is calculated as a difference between annual returns on the oil wealth and domestic consumption and is referenced to 2013 GDP when all temporary factors affecting the current account unwind. This norm of 13 percent of GDP contrasts drastically with the underlying non-oil CA deficit at end-2007 of 33 percent of GDP. In line with the dynamic version of the consumption smoothing approach to the exchange rate, this implies significant overvaluation of the exchange rate.

Table 3.5. Non-oil account norm

(Percent of GDP)	
Oil wealth (CFAF billion)	108,589
Annual return	-10.0
Domestic consumption	0.7
Non-oil CA norm	-9.4
Underlying non-oil CA	-33.4

128. **The results of the stock approach depend on the assessment of the size of oil reserves and, by implication, the oil wealth**. The term "reserves" conventionally refers to the amount of oil that has been discovered and can be extracted with existing technology under present economic conditions. Professional publications operate with numerous definitions of reserves (proved reserves, probable reserves and possible reserves are most popular), each indicating different amounts of oil available underground. Assuming that the size of reserves is actually unknown, it is possible to estimate what it should be so that the projected non-oil current account be sustainable. Simple calculations suggest that to finance by annual returns on oil wealth the actual nonoil CA of 33.4 percent of GDP, oil reserves should be at least 2.5 time larger (16.3 billion barrels compared with the current estimate of 6.5 billion barrels). Such oil deposits clearly do not exist in the CEMAC region under any definition of reserves.

Links between the two versions and the limitations of the analysis

129. **The stock version could be considered as a simplified version of the flow approach.** The flow version shows some dynamic patterns of oil revenue and the annuity value (Figure 3.4), as well as the implied pattern of long-term investment or net foreign asset accumulation (Figure 3.5). The stock version provides a point estimate of the equilibrium non-oil current account in percent of 2013 GDP. However, the stock approach can generate a similar dynamic chart for the equilibrium non-oil current account for 2008-13. Therefore, both versions of the PIH approach can be viewed as dynamic.

130. **The two versions of the PIH approach provide a handy cross-checking instrument for the robustness of the results.** Specifically, the annuity value of oil and non-oil revenue in the flow version corresponds to the sum of the annual return on oil wealth and the NPV of the changes in non-oil cash flow in the stock version. Consequently, the two version should provide similar results regarding the CA norm if the consumption tilting and domestic consumption of oil are ignored. For the purposes of this analysis, the NPV of non-oil cash flow is ignored as it is small in the stock version. Likewise, the saving-investment

balance of the private sector--which is the counterpart to the NPV of the changes in non-oil cash flow in the stock version--is also assumed to be zero in the flow version.. Indeed, the annuity value in Table 1.4 is in the range from 12 to 19 percent of GDP, which comparable the annual return on oil wealth of 13 percent of GDP in Table 1.8. Similarly, the required adjustment in the non-oil current account or required saving of oil revenue is about 17-25 percent of GDP according to the flow version while it is about 20 percent of GDP in the stock version (Table 3.8).

131. **This conclusion requires qualification.** Savings from oil wealth in this model are accumulated for the purpose of investment. Savings can be invested either in financial or physical assets, both with high positive real rates of return. If governments can invest in physical assets at returns to the economy greater than the return on financial savings, they should do so, while being mindful of limited absorption capacities. So to the extent that the governments can productively invest part of oil savings in projects with positive rates of return, the gap can be reduced by the value of productive domestic government investments in physical assets. Currently, overall government investment amounts to 7.7 percent of GDP, of which 2.6 percent of GDP is foreign-financed and 5.1 percent of GDP is domestically financed. Since the increase in oil prices, foreign and domestically-financed investment each grew by about 1 percentage point, with an additional point increase projected for the medium term. In some CEMAC countries, investment expenditure has been persistently below budgeted levels. This may suggest the existence of a severe limitation in absorptive and administrative capacity, which may not allow for additional productive domestic investment, even if the saving rate of oil revenue is increased.

132. **Both the stock and flow approaches do not take into account the fact that in oil-producing countries a large share of CA inflows and outflows are exogenously determined by the production plans of oil companies.** First, a large share of total imports are used for investment and maintenance of oil fields. Second, a significant share of the operating cost of oil companies exit the country in the form of repatriated earnings by foreign laborers. Third, a significant share of oil revenues accrue to foreign oil companies in the form of retained and unretained profits. Abstracting from some frontloading of investment needed to put online new fields, all these flows will gradually subside with the depletion of oil reserves without the need for a change in policies.

133. **Treating oil-related imports as a permanent factor may inflate CEMAC's future import needs, the required saving, and the gap between the underlying CA and the CA norm.** If data were available, a more accurate way to estimate the needed savings to be consistent with the PIH would be to remove, both from the underlying CA and from the CA norm, all oil-related imports, as well as the oil revenue (and related outflows) that accure to foreign oil companies. These revised underlying CA and CA norm would then focus only on the portion of oil revenue influencing the domestic economy. Unfortunately, the data to do this does not currently exist. Once a more comprehensive data set on royalties and profit sharing agreements becomes available, this dimension should also be captured in the analysis.

134. **The consumption-smoothing approach based on the PIH suggests than on current policies the external position is not sustainable in the long run**. To preserve external stability, CEMAC should run current account surpluses that are substantially higher than currently projected. Although the gap between the CA norm and the underlying CA suggests a substantial overvaluation, it can not be closed by any reasonable exchange rate adjustment alone. Therefore, a fundamental rethinking of polices regarding the use of oil revenue is needed.

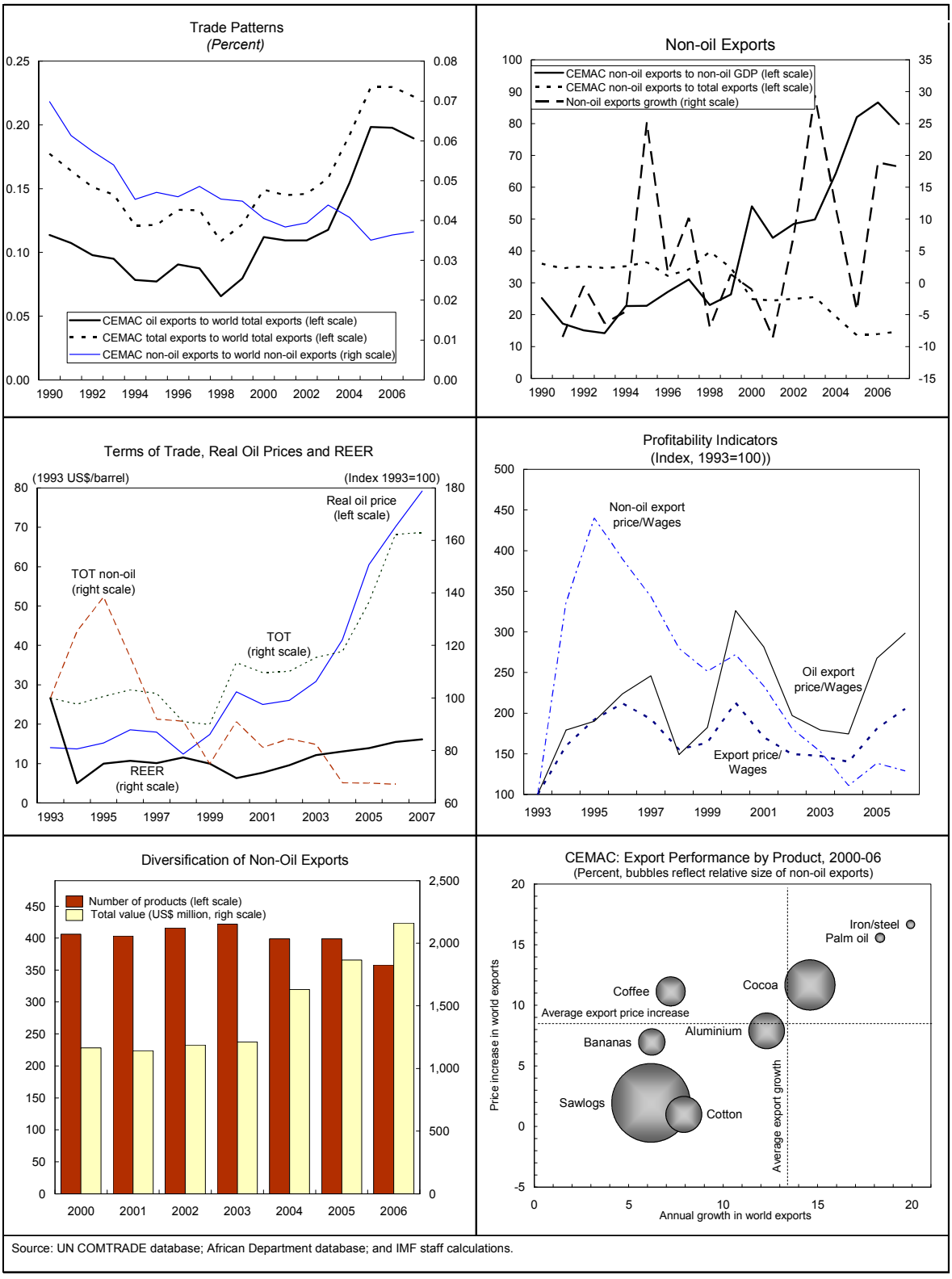
135. **Exchange rate sustainability in the long-run requires that CEMAC members save substantially larger portions of their oil revenue.** Compared with the currently projected 7 percent of GDP average annual saving, in the next five years CEMAC should save at least 17-25 percent of GDP, or 1/2 to 2/3 of their current oil revenue. The accumulation of assets can take the form of long-term financial investment or investment in physical assets with higher and sustainable real returns. If these savings are invested with a sufficiently high rate of return, during the remaining years of oil production, CEMAC countries should be able to accumulate assets needed to finance imports and consumption in the long run, with little or no need for exchange rate adjustment.

F. External Sector Performance and Non-Price Competitiveness[40]

136. **The share of CEMAC in world exports in 2004-2007 increased**. The increase in oil exports can be attributed only to higher prices, as oil production has been stagnant in recent years and even declined because of the 2006 accident at the Congo's oil extracting platform. The non-oil exports consist mainly of wood, cotton and some agricultural products and have been declining for the past several years. As a result, CEMAC is losing its already insignificant international market share in nonoil products(Figure 3.7).

[40] A detailed assessment of competitiveness in the CFA Franc zone is included in WP/07/212.

Figure 3.7. CEMAC: Export Performance, 1990-2007



Source: UN COMTRADE database; African Department database; and IMF staff calculations.

137. **Overall, profitability of the region is improving owing only to oil prices, while the profitability of the nonoil sector has been steadily declining since 2000.** The evolution of the nonoil price-to-GDP and the nonoil price-to-wage indices—the two direct measures of profitability—clearly suggest that profitability of the nonoil sector is worsening. Lack of comparable and reliable information on factor cost and factor productivity, other than wage indices, does not allow a more detailed analysis of profitability and hence competitiveness.

138. **Survey-based indicators suggest that CEMAC lags behind most other countries in comparable levels of development on key indicators**:

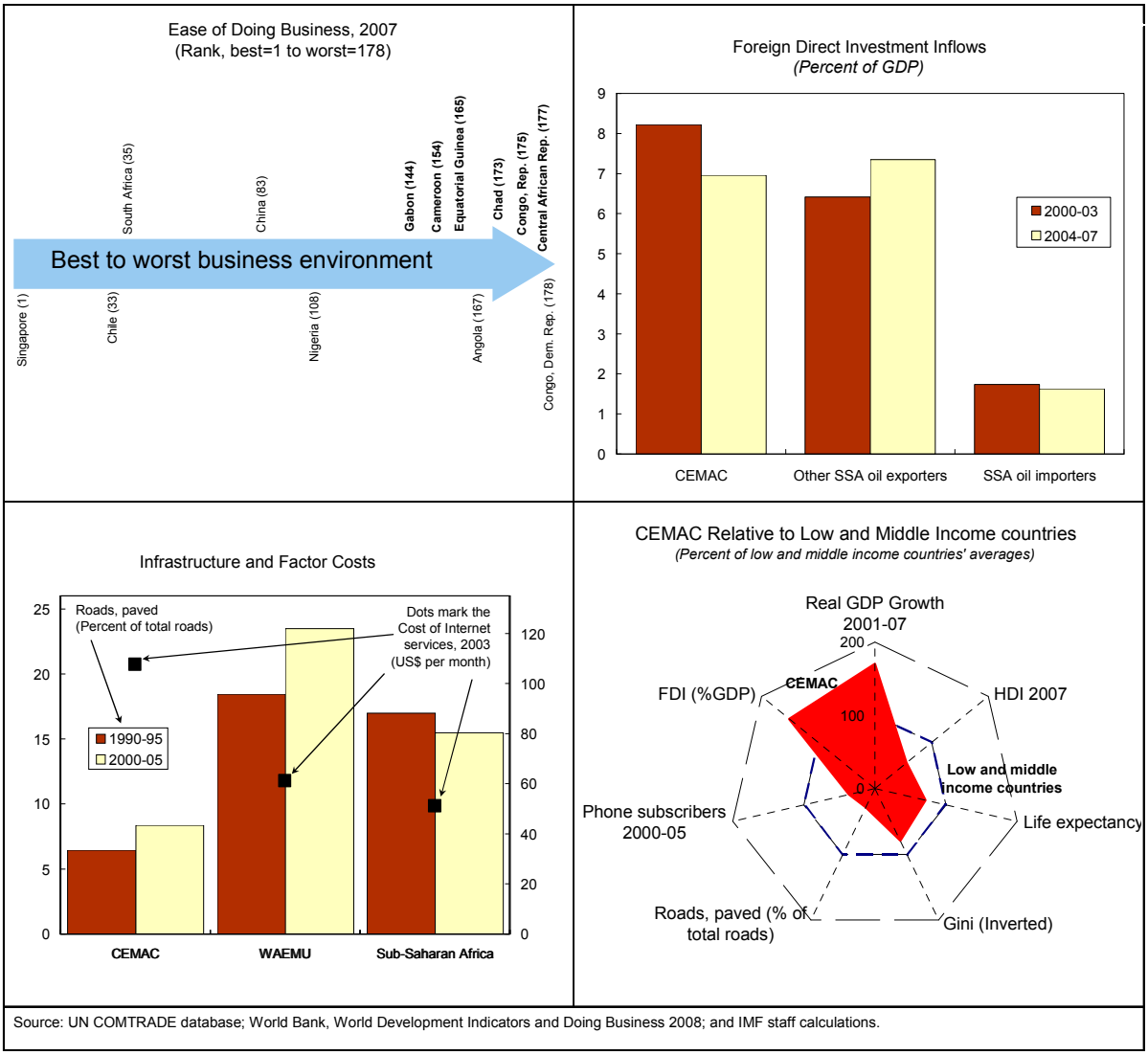
- CEMAC countries fare poorly on the ease of doing business. According to the Doing Business indicators compiled by the World Bank, CEMAC ranks well below the median on costs of starting business, hiring costs, time for exports and imports, total tax rates, and the overall business environment (Figure 3.8).

- CEMAC countries rank low on overall competitiveness by the World Economic Forum's Global Competitiveness Report. Only two CEMAC countries are ranked in the report. Out of 131 countries, Chad is ranked at the bottom and Cameroon is ranked 116.

- CEMAC countries lag behind on governance. Although they have relatively high rankings on political stability, CEMAC countries are among the worst performers in government effectiveness, control of corruption, regulatory quality, and the rule of law.

- Finally, CEMAC's deficiencies in human development are staggering: 1990-2006 life expectancy declined from 50 to 47 years, infant mortality increased, and the primary education completion rate and healthcare-to-GDP ratio remained lower than even the average for Sub-Saharan Africa.

Figure 3.8. CEMAC: Non-Price Competitiveness Indicators



Source: UN COMTRADE database; World Bank, World Development Indicators and Doing Business 2008; and IMF staff calculations.

G. Conclusions

139. **The multidimensional approach to the assessment of external stability yields a mixed picture**. The *analysis of balance of payment vulnerabilities* suggests no immediate threat to external stability. Although the current account is volatile and extremely vulnerable to terms of trade shocks, the reserve coverage is adequate, capital and financial flows are well-monitored and non-volatile, and the arrangements with France provide a reliable anchor for the exchange rate. The *analysis of the REER developments* points to the growing appreciation, which implies a gradual loss of price competitiveness and should be watched closely. At the same time, appreciation may reflect a transition to a higher level of the equilibrium REER. The backward-looking *equilibrium REER* analysis of the exchange rate level relative to its fundamentals points to a minor overvaluation at end-2007, but the results

are sensitive to model specifications. However, the forward-looking *consumption smoothing approach to the REER* clearly suggests that on current policies of consuming most of the oil windfall, the exchange rate is not sustainable in the long-run. The CEMAC region should run higher current account surpluses, and save or productively invest a substantially larger portion of its oil revenue now to sustain imports and consumption in the long run. Finally, the analysis of *external sector performance and non-price competitiveness* clearly points to shrinking export shares of the nonoil sector. This implies that the CEMAC is not making sufficient progress in creating a vibrant nonoil sector, which could in time replace the oil sector, therefore compromising its external stability in the long run.

140. **Overall, the REER so far remains consistent with external stability, although to safeguard this stability in the long run CEMAC countries should focus on nonoil growth.** As oil production is projected to taper off in most countries, the current period of relative external stability may not be long-lasting and should be used to create a solid basis for longer-term stability. To avoid the need for an abrupt adjustment of the exchange rate level and regime, CEMAC should treat the current high oil revenue as a temporary factor while saving and productively investing their substantial portion to secure economic diversification.

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APPENDIX

Variable Definitions and Sources[41]

The data consist of annual observations for 1969 through 2007, with the index 2000=100 for the LREER and LTOT variables. The regional aggregate variables for CEMAC were constructed using member country annual observations and nominal GDP weights. Equatoria Guinea was excluded from the analysis because it joined the union only in 1985.

Country real effective exchange rates before 1980 were unavailable in the IMF Information Notice System (INS) database and were constructed based on CPI indices from the World Economic Outlook with partner weights renormalized. The "foreign" variable (used for the calculation of the productivity proxy) was calculated as the renormalized weighted average based on the INS weights for the REER. The largest CEMAC partner countries (weights) are: France (0.42), United States (0.15), Germany (0.13), Japan (0.11), Italy (0.10) and Belgium (0.08).

Acronyms, definitions, and sources for the variables are as follows:

LREER Natural logarithm of the real effective exchange rate (Index 2000=100)
Source: Information Notice System (INS) and IMF staff calculations.

LNCGR Natural logarithm of public consumption expenditure to GDP
Source: World Economic Outlook (WEO).

LTOT Natural logarithm of terms of trade (Index 2000=100)
Source: World Economic Outlook (WEO).

LINV Natural logarithm of gross capital formation to GDP
Source: World Economic Outlook (WEO).

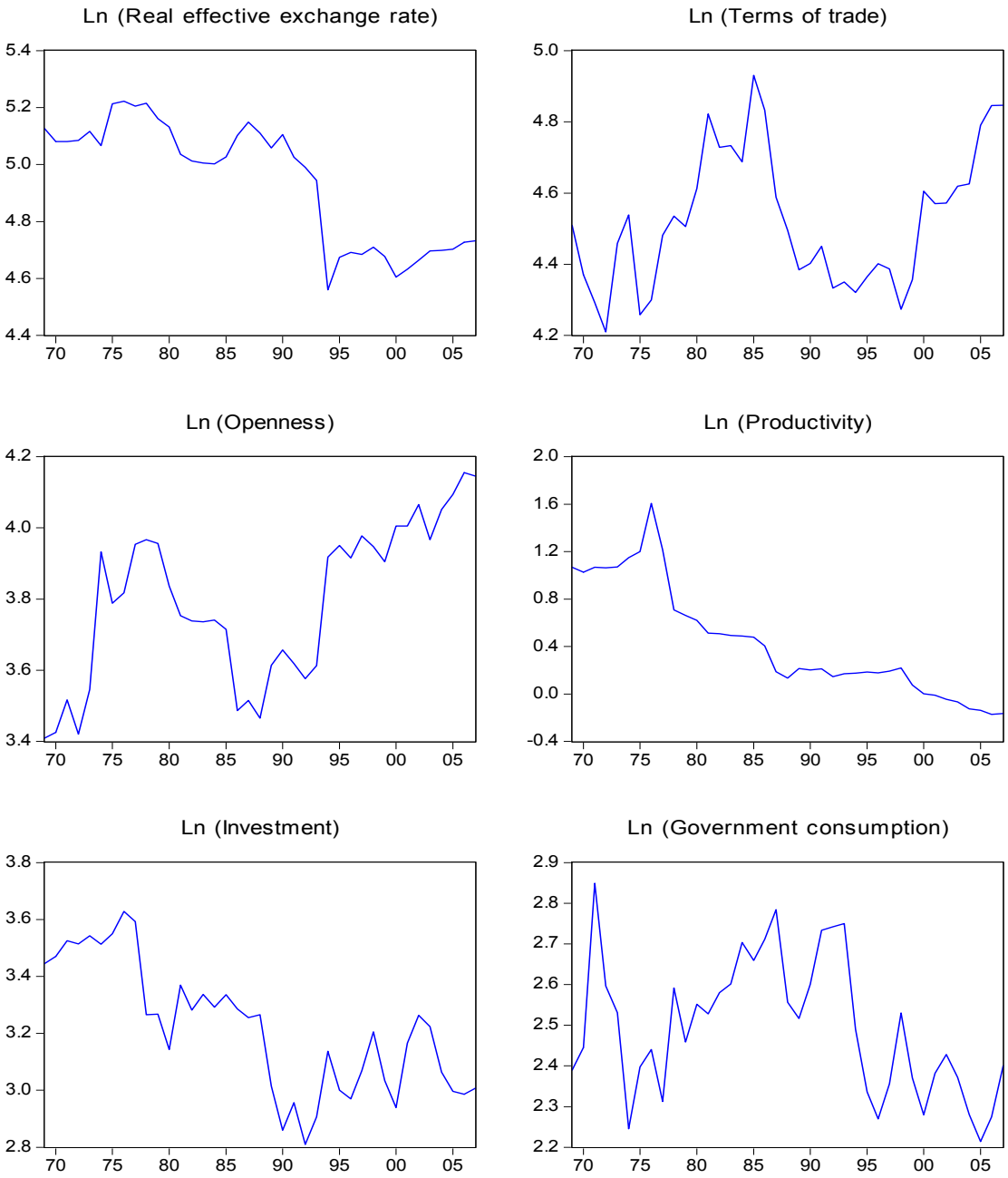
LPROD Natural logarithm of real per capita GDP relative to main trade partners, normalized to 1 in 2000 with weights as discussed above
Source: World Economic Outlook (WEO).

LOPEN Sum of exports and imports to GDP
Source: World Economic Outlook (WEO).

[41] This section of the appendix draws on SM/07/199 prepared by Charalambos Tsangarides.

Cointegration variables

Figure A.1. CEMAC: Cointegration Variables



Unit root tests

Table A.1. Unit Root Tests

Variables/Groups Levels and Differences

Series Unit Root Test Summary

Variable	ADF	p-value	Conclusion
ln REER	-1.02	0.74	I(1)
ln TOT	-1.62	0.46	I(1)
ln CGR	-2.96	0.05	I(O)
ln INV	-1.64	0.45	I(1)
ln PROD	-1.59	0.48	I(1)
ln OPEN	-1.40	0.57	I(1)
D ln REER	-6.26	0.00	I(0)
ln TOT	-5.87	0.00	I(0)
D ln CGR	-7.06	0.00	I(0)
ln INV	-6.40	0.00	I(0)
D ln PROD	-6.02	0.00	I(0)
D ln OPEN	-6.46	0.00	I(0)

Notes:

[1] D denotes the difference operator

[2] Null: Unit Root (assumes a common unit root process)

[3] Null: Unit Root (assumes a common unit root process)

[4] Null: No Unit Root (assumes a common unit root process)

Note:

Individual unit root tests choose lag lengths using the Schwarz citerion, include intercept and trend.

Table A.2. Panel Unit Root Tests
Variables/Groups Levels and Differences

ln(REER)				*ln(TOT)*			
Test	Statistic	p-value	Conclusion	Test	Statistic	p-value	Conclusion
Levels				*Levels*			
Levin, Lin & Chu t*	-0.30	0.38	I(1)	Levin, Lin & Chu t*	-1.08	0.14	I(1)
Im, Pesaran and Shin W-stat	-0.04	0.48	I(1)	Im, Pesaran and Shin W-stat	-0.30	0.38	I(1)
ADF - Fisher Chi-square	9.53	0.48	I(1)	ADF - Fisher Chi-square	8.83	0.55	I(1)
PP - Fisher Chi-square	9.48	0.49	I(1)	PP - Fisher Chi-square	9.04	0.53	I(1)
Differences				*Differences*			
Levin, Lin & Chu t*	-9.44	0.00	I(0)	Levin, Lin & Chu t*	-9.75	0.00	I(0)
Im, Pesaran and Shin W-stat	-12.35	0.00	I(0)	Im, Pesaran and Shin W-stat	-11.74	0.00	I(0)
ADF - Fisher Chi-square	123.56	0.00	I(0)	ADF - Fisher Chi-square	117.71	0.00	I(0)
PP - Fisher Chi-square	123.77	0.00	I(0)	PP - Fisher Chi-square	127.65	0.00	I(0)

ln(CGR)				*ln(INV)*			
Test	Statistic	p-value	Conclusion	Test	Statistic	p-value	Conclusion
Levels				*Levels*			
Levin, Lin & Chu t*	0.07	0.53	I(1)	Levin, Lin & Chu t*	-1.38	0.08	I(0)
Im, Pesaran and Shin W-stat	0.57	0.72	I(1)	Im, Pesaran and Shin W-stat	-1.46	0.07	I(0)
ADF - Fisher Chi-square	10.27	0.42	I(1)	ADF - Fisher Chi-square	16.15	0.10	I(0)
PP - Fisher Chi-square	10.68	0.38	I(1)	PP - Fisher Chi-square	37.06	0.00	I(0)
Differences				*Differences*			
Levin, Lin & Chu t*	-11.24	0.00	I(0)	Levin, Lin & Chu t*	-7.08	0.00	I(0)
Im, Pesaran and Shin W-stat	-11.48	0.00	I(0)	Im, Pesaran and Shin W-stat	-8.86	0.00	I(0)
ADF - Fisher Chi-square	115.00	0.00	I(0)	ADF - Fisher Chi-square	84.40	0.00	I(0)
PP - Fisher Chi-square	100.31	0.00	I(0)	PP - Fisher Chi-square	161.81	0.00	I(0)

ln(PROD)				*ln(OPEN)*			
Test	Statistic	p-value	Conclusion	Test	Statistic	p-value	Conclusion
Levels				*Levels*			
Levin & Lin rho	-0.32	0.38	I(1)	Levin & Lin rho	-1.10	0.13	I(1)
Levin & Lin t-rho	1.08	0.86	I(1)	Levin & Lin t-rho	-0.88	0.19	I(1)
Levin, Lin & Chu ADF	5.14	0.88	I(1)	Levin, Lin & Chu ADF	13.64	0.19	I(1)
Im, Pesaran and Shin ADF-t	3.48	0.97	I(1)	Im, Pesaran and Shin ADF-t	13.04	0.22	I(1)
Differences				*Differences*			
Levin & Lin rho	-8.20	0.00	I(0)	Levin & Lin rho	-13.18	0.00	I(0)
Levin & Lin t-rho	-8.77	0.00	I(0)	Levin & Lin t-rho	-12.27	0.00	I(0)
Levin, Lin & Chu ADF	83.61	0.00	I(0)	Levin, Lin & Chu ADF	124.09	0.00	I(0)
Im, Pesaran and Shin ADF-t	92.95	0.00	I(0)	Im, Pesaran and Shin ADF-t	149.76	0.00	I(0)

Notes:

[1] The tests based on the Levin and Lin (1992, 1993) and Levin, Lin and Chu (2002) rho, t-rho and ADF statistics, are based on pooled, within-dimension, estimators and hence consider the parameters of interest as homogeneous across countries. The test based on the Im, Pesaran, and Shin (2003) ADF-t statistic, is based on group mean estimator and treats the parameters of interest as heterogeneous among members.

[2] The tests are one sided and the statistics are normally distributed N(0,1) under the null hypothesis of no cointegration. Under the alternative hypothesis, the statistics diverge to negative infinity (and therefore the left tail is used to reject the null).

[3] One and two asterisks indicate rejection at 10 and 5 percent, or better, respectively.

Cointegration tests

Table A.3. Cointegration Tests

Johansen Cointegration Tests[1]

Number of Hypothesized Cointegration Relations	Trace Statistic	p-value	Max-Eigenvalue Statistic	p-value
None	102.43	0.02	39.65	0.06
At most 1	62.78	0.16	27.44	0.24
At most 2	35.34	0.43	25.92	0.08
At most 3	9.42	0.99	6.93	0.96
At most 4	2.49	0.99	2.48	0.98
At most 5	0.01	0.92	0.01	0.92

FMOLS Cointegration Tests[2]

Test	Statistic	p-value
Panel v-stat (non-parametric)	-2.30	0.03
Panel rho-stat (non-parametric)	1.81	0.08
Panel PP-stat (non-parametric)	1.74	0.09
Panel ADF-stat (parametric)	1.95	0.06
Group rho-stat (non-parametric)	1.73	0.09
Group PP-stat (non-parametric)	0.94	0.26
Group ADF-stat (parametric)	0.20	0.39

Notes:

[1] The test suggests presence of cointegration, with one single cointegrating vector.

[2] All reported values are distributed N(0,1) under the null of unit root or no cointegration. The tests only weakly support cointegration, as only one of the test statistics is significant.

Residuals diagnostics and model reduction tests

Table A.4.. Diagnostic Tests for Residuals

Johansen Procedure

Test	Statistic	Value	p-value
Vector AR 1-2 test	F(72,38)	1.37	0.14
Vector Normality Test	Chi^2(12)	51.00	0.00
Vector heroskedasticity test	Chi^2(252)	267.84	0.23
AR 1-2 test			
LREER	F(2,21)	0.59	0.56
LTOT	F(2,21)	2.33	0.12
LNCGR	F(2,21)	0.83	0.44
LINV	F(2,21)	1.72	0.20
LPROD	F(2,21)	4.26	0.02
LOPEN	F(2,21)	0.63	0.54
Normality Test			
LREER	Chi-square(2)	6.84	0.03
LTOT	Chi-square(2)	7.55	0.00
LNCGR	Chi-square(2)	1.66	0.44
LINV	Chi-square(2)	0.89	0.64
LPROD	Chi-square(2)	54.36	0.00
LOPEN	Chi-square(2)	3.98	0.14
Heteroskedasticity Test			
LREER	F(12,10)	0.29	0.98
LTOT	F(12,10)	1.01	0.50
LNCGR	F(12,10)	0.24	0.99
LINV	F(12,10)	0.70	0.72
LPROD	F(12,10)	2.85	0.05
LOPEN	F(12,10)	0.61	0.80

Table A.5. Tests for Model Reduction

Johansen

Model	Log Likelihood	Schwartz Criterion	Hannan-Quinn Criterion	Akaike Criterion
VAR with 3 lags of endog. variables	406.85	-8.62	-12.810	-15.02
VAR with 2 lags of endog. variables	349.29	-8.99	-12.13	-13.79
VAR with 1 lag of endog. variables	285.08	-8.98	-11.070	-12.17

Model reduction[1]	Statistic	Value	p-value
VAR with 3 lags to VAR with 2 lags	F(36,29)	0.9	0.62
VAR with 3 lags to VAR with 1 lag	F(72,38)	1.38	0.14
VAR with 2 lags to VAR with 1 lag	F(36, 55)	2.01	0.01

Note:

[1] The information criteria reported in the upper part of the table each suggest use of a different specification. The F-tests for model reduction reported in the lower part suggest that inclusion of one lag of the endogenous variables is sufficient. On this basis, the specification with one lag was chosen.