Economic Commission for Africa

Macroeconomic Convergence in Central Africa:

A Survey of the Theory and Empirical Evidence

Alberto Bagnai

May 2010

Economic Commission for Africa

Macroeconomic Convergence in Central Africa:

A Survey of the Theory and Empirical Evidence

Alberto Bagnai*

May 2010

* Dipartimento di Economia e Storia del Territorio Università "Gabriele D'Annunzio" viale Pindaro, 42, I-65127 Pescara (Italy) bagnai@unich.it

Table of Contents

1. Premise: Convergence, Macroeconomic Convergence, Macroeconomic Policy Convergence

This paper is the output of a policy study commissioned by UNECA in the framework of the capacity building project "Enhancing the capacity of member States to achieve macroeconomic policy convergence". As a part of this project, UNECA has requested a policy study aimed at "survey existing literature and provide empirical evidence on macroeconomic policy convergence, highlight pertinent international experiences and summarize the debate on the cons and pros of macroeconomic convergence". The study should also "use country-level as well sub-regional information and data, covering the main regional economic communities in Central Africa (ECCAS, CEMAC) to assess macroeconomic convergence in the sub-regions" and "provide specific policy suggestions on the design and implementation of strategies for macroeconomic convergence in these regions."

Defining "macroeconomic convergence" may prove less self-evident than it seems at first sight. You will usually not find "macroeconomic convergence" in the index of any macroeconomics textbook (e.g., Dornbusch et al. (2004), Mankiw and Taylor (2008)). If you look for "convergence", you will be brought invariably to a discussion of the neoclassical exogenous and endogenous growth models. The same happens if you have a quick look at the scientific literature, using some of the most widespread bibliographic tools, like the Econlit database. If you search for "convergence" (in all fields) you get 21160 items, but a number of these papers deals with methodological issues in econometrics; if you narrow down the search looking for "convergence and growth", say, you still find a respectable 15207 items; if you instead search for "macroeconomic convergence" the harvest is surprisingly meagre: only 41 items, of which only 9 mention "macroeconomic convergence" in the title, of which 4 refers to African countries (none to the CEMAC)[1], and the other to the European Monetary Unions (EMU) and the Eastern Europe transition countries.

"Convergence" in the context of macroeconomic growth theory refers to the process by virtue of which less developed countries will "catch up" with advanced countries, owing to the law of diminishing returns on capital (Barro and Sala-i-Martin, 1992). The crucial question in this respect is: how long will it take for per capita GDP of less developed countries (LDCs) to converge to the levels experienced in developed countries (DC's)? Is this process spontaneous, or are there any policies able to speed up it? Put in the geographical framework of our study, the question would become: how long will it take for CEMAC annual per capita GDP (equal to USD 775 at 2000 prices in 2006) to catch up with, say, the Euro area per capita GDP (equal to USD 21746)? This may prove a difficult question to answer (the "convergence debate" is not yet settled; Islam, 2003), but at least it is a question that makes sense and has an obvious relevance for pro-poor policies.

A layman may (legitimately) wonder in discovering that this convergence, i.e., the convergence macroeconomic textbooks speak of, is not what multilateral and

[1] In fact, there is a very recent contribution on macroeconomic convergence on CEMAC which is not yet listed in Econlit: Carmignani (2010).

supranational agencies mean for "macroeconomic convergence". While "convergence" *tout court* is related to growth theory, in the economic literature the term "macroeconomic convergence" appears to be related to Optimum Currency Area (OCA) theory (Mundell, 1961; Tavlas, 1993; Broz, 2005). Broadly speaking, "macroeconomic convergence" refers to the convergence of a set of macroeconomic fundamentals among a given set of countries, which can be seen as either a prerequisite for, or as the outcome of, a successful monetary integration agreement.[2] This use of the terms "macroeconomic convergence" has become relatively widespread in the Nineties, during the run-up of EU countries to the EMU, when the "convergence to the Maastricht parameters" had become the main concern of most European policymakers. Summing up, the study of "macroeconomic convergence" deals with the feasibility/optimality (ex ante), or the sustainability/stability (ex post) of a given monetary integration agreement. It is fair to say that the relation of this "macroeconomic convergence" with convergence in growth-theoretical sense is rather loose, unless one is willing to endorse the hypothesis that monetary integration necessarily fosters (pro-poor) growth (as we shall see in the following, the evidence on this point is controversial).[3]

It should be clear by now that the economic literature does not discuss the "pros and cons of macroeconomic convergence" *per se*. Rather, the assessment of "macroeconomic convergence" is part of a more general evaluation of the pros and cons of monetary integration. In this framework, macroeconomic convergence is approached from the point of view of the "reduction of damages", rather than from that of the "increase of benefits". Many examples of this peculiar attitude will be given below. For instance, inflation convergence is requested in order to avoid competitiveness shifts among member countries that may lead to disruptions in trade and ever growing external imbalances, even though convergence to the bottom (to the lowest inflation country) may imply unemployment costs for other member countries (except in the case of vertical Phillips curve, which is almost invariably assumed rather than tested). In the light of this simple example, whose relevance is proved enough by the recent Eurozone developments, the answer to the question asked by Ben Hammouda *et al.* (2007): "does macroeconomic convergence lead to growth?" is extremely likely to be negative.

OCA theory has known several stages of development since its first statement in the early Sixties. As a consequence, the meaning of macroeconomic convergence within the more general framework of the assessment of the pros and cons of an OCA has developed. In particular, as stated before, the convergence of some macroeconomic fundamentals (e.g., the inflation rates) has been considered in turn as either a *prerequisite for*, or as a (desirable) *outcome of* OCA membership. In principle, these two perspectives are rather different, if not completely opposite. If "macroeconomic convergence" is a prerequisite (as envisaged by "old" OCA theory), it is meaningful for a country interested in joining a monetary union to assess it and look for policies that may eventually enforce

[2] More precisely, this literature refers to "nominal" and "real convergence", rather than to "macroeconomic convergence", one of the most debated issue being that of whether "nominal" convergence (i.e., convergence of nominal variables like inflation rate, interest rates, etc) as envisaged in Maastricht treaty is likely to bring to "real" convergence (i.e., convergence of real macroeconomic fundamentals).

[3] Just to give a hint of what we mean by controversial, we recall that the estimates of the impact of monetary union membership on trade (which is a natural transmission mechanism from union membership to economic growth) are in a range between 300% (Rose, 2000) to 5% (Baldwin, 2006).

it, while countries already belonging to a monetary union have no obvious interest in assessing it, unless in the extremely unlikely case that they desire (or are forced) to leave the union. If instead "macroeconomic convergence" is to be seen as an outcome, the only policy measure needed to ensure it is simply to join the OCA: in this respect, the assessment of macroeconomic convergence is relatively useless for a country that does not belong to a monetary union, as it is uninformative on what could possibly occur should the country join the union;[4] at the same time, taken in this perspective (i.e., the perspective of the "new" or "endogenous" OCA theory), the study of convergence may become interesting for countries already belonging to a currency area, as it allows them to verify the "endogenous OCA" assumption and to evaluate the macroeconomic costs related to currency area membership. Needless to say, as CEMAC countries belong by definition to a monetary union, the more recent studies on their macroeconomic convergence have been carried out exactly in this perspective (see Carmignani, 2010).

"Macroeconomic policy convergence" is a closely related concept. The so-called "inconsistent triad" problem (Gandolfo, 2002, chap. 20) makes clear that in a currency area with perfect capital mobility there is no room for monetary independence at a national level. As a consequence, a common monetary policy, possibly carried out by a supranational central bank, is therefore widely seen as a prerequisite of a viable monetary union. In other words, monetary integration implies that national monetary policies *need* to converge (even in the absence of a common currency). The question is still open as to whether, and to what extent, *fiscal policies* should also converge among the members of a currency area. Multilateral surveillance agreements, akin to the Stability and Growth Pact in the EMU, usually set bounds to some measures of fiscal policy stance, thereby implicitly endorsing the view that fiscal policy *convergence* is also needed for a viable monetary union. Interestingly enough, the economic literature does not consider fiscal policy coordination in a currency union as a self evident matter (see e.g. Gandolfo, 2002), and some authors question both the need of fiscal policy coordination, and the way this is enforced in multilateral surveillance programmes.

Taking stock of this brief discussion, we are now in a position to define more precisely the content of this study and to set out its structure.

First, we will deal with macroeconomic convergence in the framework of monetary integration theory, i.e., convergence in the meaning of e.g. De Grauwe (1992). In other words, unlike previous studies such as UNECA (2007), we shall not consider convergence in a growth-theoretical sense, as studied for instance by Barro and Sala-i-Martin (1992). This choice does not reflect a value judgment about what issue is more important for "accelerated and sustained pro-poor growth" in Central Africa. It rather responds to the need of defining more precisely the scope of our research, by concentrating on issues that are crucial for the conduct of macroeconomic policy in a monetary union, and more precisely for the economic rationale of multilateral surveillance programmes.

Second, in order to precise the meaning of macroeconomic convergence and macroeconomic policy convergence, we will need to summarise briefly the main results

[4] As Frankel and Rose (1997) put it, this kind of assessment is subject to a standard "Lucas critique" argument.

of OCA theory. This will enable us to put in a correct perspective both the convergence criteria set out in regional monetary integration agreements, and the empirical studies on macroeconomic convergence carried out at the regional level. As we shall see, in the theory of OCAs nothing suggests that membership in an OCA will allow poor countries to grow faster than rich ones: in other words, the link between macroeconomic policy convergence and growth-theoretical convergence is very loose or non-existent at the theoretical level.

Third, in this study we will argue that the study of macroeconomic convergence *per se* makes little sense if it is not supported by a careful empirical verification of the hypotheses underlying the notion of optimality of a currency area. This is especially true when convergence *does not* occur, as it appears to be the case of CEMAC countries (although this evidence shall be qualified). If convergence does not occur, it becomes crucial to understand why it does not, in order to quantify the costs determined by the non convergence, and to take the right policy measures.

The paper structure is as follows. Section 2 reviews OCA theory and establishes the role of macroeconomic convergence within the "old" and "new" version of the theory. Section 3 focuses on macroeconomic policy convergence: it first reviews the literature on convergence criteria and multilateral surveillance programmes, and then evaluates CEMAC multilateral surveillance programme in the light of the relevant literature. Section 4 deals with the empirical literature focussing on macroeconomic convergence (and macroeconomic policy convergence) in Sub-Saharan Africa (henceforth, SSA) countries: it highlights the main results, by critically reviewing the methodology, and proposes fresh results based on a more rigorous testing methodology.

Before proceeding, a very brief remark: convergence, as we shall see, is a long-run issue. As a consequence, in the following we will assess it using the longest possible sample of data. In so doing, we will refer to Cameroon, Chad, Central African Republic, Congo, Equatorial Guinea and Gabon as "CEMAC countries", even in cases in which this definition may be incorrect in historical terms. In fact, CEMAC was established in 1994. However, five out of the six countries mentioned above (the former French colonies: Cameroon, Chad, Central African Republic, Congo and Gabon) share the same money since the beginning of the 20th century (be it the French franc or the CFA franc). Equatorial Guinea joined the CFA franc zone in 1984. Time series data on the main macroeconomic indicators are available since at least 1960, when the CFA zone countries gained their independence. Although at that time CEMAC did not yet exist, we will for short speak of "CEMAC" data even before 1994.[5]

[5] As specified in the text, the historical fact that the CEMAC Treaty was signed in 1994 does obviously not contradict the economic fact that some form of economic and monetary integration existed before. In particular, since December 26, 1945, most French colonies in Africa joined the CFA franc, and since the Brazzaville Treaty of December 8, 1964, the current CEMAC members decided to establish the UDEAC (*Union Douanière des Etats de l'Afrique Centrale*). Moreover, on 18 October 1983 the UDEAC members decided to join other Central African states in the ECCAS (*Economic Community of Central African States*). It must be stressed that monetary union in French colonies predates even the inception of the CFA franc, because before 1945 these colonies adopted the French franc.

2. OCA theory and macroeconomic convergence

As Gandolfo (2002, p.333) aptly puts it, OCA theory derives its rationale from the inconclusiveness of the debate on fixed versus flexible exchange rates, for the simple reason that if fixed exchange rate were proven always superior, there would be only one OCA, coinciding with the world[6], whereas if flexible exchange rates were shown to be always superior, no currency area would be optimal. OCA theory therefore exists for the very reason that "no single currency regime is right for all countries or at all times" (Frankel, 1999). However, as Tavlas (1993) clearly states, "the basic case" for evaluating the benefits of monetary integration rests upon the desirability of "exchange rate certainty" (meant to include both fixed exchange rates, and the limit case of a single currency). The logical circularity of the argument is rather striking: we have to resort to the results of an inconclusive debate (that on the desirability of fixed exchange rates) in order to settle another debate (the definition of OCAs) whose *raison d'être* is the inconclusiveness of the first one. This logical circularity can be avoided if one recognizes that the advantages (or costs) of belonging to a currency union do not depend exclusively on exchange rate "certainty", but also on other factors, as stressed by the so called "new" OCA theory (Gandolfo, 2002). Both the "old" and "new" OCA theory consider some kind of macroeconomic convergence among the prerequisite or the outcomes of OCA membership.

In this section we briefly recall why macroeconomic convergence is a desirable outcome (or requisite) for countries belonging to monetary unions, what kind of convergence is considered by the literature, and recall some basic stylized facts related to the optimality of CEMAC.

2.1 Why should we study convergence and what convergence should we study?

The heading of this section asks a well defined question, yet one that is often overlooked in empirical studies, including those related to CEMAC. In order to avoid the "measurement without theory" problems that plague this literature, thereby reducing its usefulness, we shall briefly review the main theoretical arguments in favour of the study of convergence, distinguishing between the "old" and "new" approach to OCA theory. Remark that the "old" approach is still topical: it is widely recognized that "new" theories do still refer to most of the "old" criteria, the only difference being that "new" theories adopt a "cost-benefit" instead of a "single criterion" approach and gauge the criteria in the light of some relatively recent debates in macroeconomic theory, like Friedman (1968) natural rate hypothesis or Lucas and Rapping (1969) analysis of the short-run Phillips curve, and Barro and Gordon (1982) analysis of reputational issues in the rules vs. discretion debate.[7]

[6] An hypothesis that as been strongly advocated by Mundell in a number of recent papers; Mundell (2005, 2009).

[7] On the relevance of "old" approaches see Tavlas (1993), and Gandolfo (2002).

2.1.1 Convergence in the old OCA theory

According to the "old OCA theory" the criteria that a country should meet in order to benefit (or not to be damaged) from a monetary union are the following (we list them in chronological order):

1) *flexibility of prices and wages* (Friedman, 1953): it reduces the need to adjust employment or the nominal exchange rate in reaction to country specific shocks;
2) *high interregional factor (especially labour) mobility* (Mundell, 1961): it allows a country or region to absorb shocks without the need of adjusting the nominal exchange rate;
3) *high degree of openness* (McKinnon, 1963): the more open the economy, the lower the impact of nominal exchange rate adjustments on competitiveness, hence the lower the cost of renouncing nominal exchange rate as a policy tool; moreover, the more open the economy, the larger the costs of resource reallocation between tradable and non tradable sectors after a nominal exchange rate adjustment;
4) *high product diversification* (Kenen, 1969): it helps overcoming industry-specific shocks, thus reducing the need to resort to nominal exchange rate adjustments;
5) *high fiscal integration* (Kenen, 1969): it allows to absorb the impact of asymmetric shocks through fiscal transfers from one to another country, thereby reducing the need of nominal exchange rate adjustments;
6) *convergence of inflation rates* (Fleming, 1971): differences in inflation rates cause variations of the terms of trade and give rise to persistent or even rising current account disequilibria.
7) *political factors* (Mintz, 1970), i.e., the "political will to integrate on the part of the prospective members".

Summing up, the only convergence considered by "old" OCA theory is that of *inflation rates*, and this is only *one* among *seven* criteria of optimality. In other words, "old" OCA theory provides no economic rationale for analyzing the convergence of variables like the money stock, prices, fiscal receipts, or GDP. Therefore, a first answer to the questions raised in the heading of this section is: we should study the convergence of the inflation rates (not prices!), because lack thereof will cause current account disruption within a monetary union. The recent crisis of the Euro area is a rather telling example of this phenomenon.

2.1.2 Convergence in the new OCA theory: the cost-benefit approach

As stated above, a distinct feature of "new" theory is that it weighs the benefits of OCA membership against its costs. The major benefits are:

1) *macroeconomic stability through the solution of time-consistency problems* (Giavazzi and Pagano, 1988): by joining a currency union with a low-inflation country, the monetary authorities of an otherwise inflation-prone country take a credible commitment towards anti-inflation policies. This increases

their reputation, thus solving the time-consistency problems and favouring convergence of inflation rates to the bottom. Under the extreme hypothesis of vertical short-run Phillips curve, this outcome is only beneficial, in that it minimizes the costs of inflation without increases in unemployment.

2) *increase in trade*: according to Rose (2001), joining a monetary union causes a sizeable increase in trade (due to the elimination of exchange rate risk, to enhanced transparency in prices, to greater financial integration); this, in turn, would synchronize the economic cycles of member countries through increased demand spillovers.
3) *saving on exchange reserves* (Mundell, 1973; Frenkel, 1999): by joining a monetary union member countries no longer need international reserves for intra-regional transactions; moreover, the pooling of foreign exchange reserves entails an international risk sharing, determining a better coverage of imports requirements than would be otherwise possible.
4) *political advantages* (Gandolfo, 2002): a monetary union "carries more weight than the single countries in negotiating as a whole with outside parties".

Among the major costs, we recall:

1) *loss of autonomy in monetary policy* (De Grauwe, 1992): by joining a monetary union a country renounces an autonomous monetary policy, thus loosing a degree of freedom in reacting to external shocks. Several issues are here at stake regarding the shocks:
   a. *symmetry of shocks*: if member countries are hit by an asymmetric shock, this will either push for a discontinuation of the union (if there is no leader country), or exacerbate domestic business cycles in the peripheral countries (if there is a leader country). Therefore, the *degree of symmetry of the shocks becomes* an important criterion (Alesina *et al*., 2002).
   b. *synchrony of business cycles*: if member countries are hit by the same shock, but are in different stages of the business cycle, they may require different policy answers, which increase the costs of sharing the same monetary policy. As a consequence, the *degree of synchronization of business cycles among member countries becomes* an important criterion.[8]
   c. *nature of the shocks*: the cost of renouncing monetary policy varies according to the nature of the shocks (Gandolfo, 2002). The "modern view" stresses the superiority of fixed exchange rate as a stabilizing tool in case of money demand shock and aggregate supply shocks, while flexible exchange rates are superior in case of aggregate demand shocks. A definite answer, however, is impossible because it crucially depends on

[8] This criterion is often defined business cycle "symmetry". Since symmetry is the "correspondence of form on opposite sides of a dividing line", it turns out that if one observes the plot of the cyclical component of output, an expansion (above the horizontal axis) is symmetric to a recession (below the horizontal axis). In other words, cycles are symmetric whenever countries are on *opposite* phases of the business cycle. For the same reason, it would be more correct to speak of "correlated", instead of "symmetric", shocks.

the economy structural parameters (see Melitz, 1991, and Gandolfo, 2002, App. M, for a more formal treatment).[9]

2) *increased specialization in production* (Artis, 1991): flexible exchange rates induce the scattering of production facilities across countries as a hedging strategy against exchange rate risk. Under fixed exchange rate the countries are encouraged to exploit their comparative advantages, resulting in a more spatially concentrated and specialized production. This increases the costs of adjustment in response to asymmetric shocks. However, Frankel and Rose (1997) argue that this effect is offset by the trade promotion effect: therefore, the net result of joining a monetary union would be business cycle synchronization. In other words, the formation of OCA is an endogenous process (the so-called *endogenous OCA hypothesis*).

3) *perverse incentive effects on fiscal policy*

   a. Tornell and Velasco (2001) dispute the view that fixed exchange rates provide more "discipline" than flexible rates. They point out that in the presence of a sizeable stock of foreign exchange reserves, under fixed exchange rates an unsustainable path of public spending can be protracted over time, until the stock of reserves is completely depleted, thus requiring a costly adjustment of the peg. In case of flexible exchange rates the unsound policies are immediately punished through nominal exchange rate devaluation. Therefore, flexible exchange rates may provide more discipline.[10]

   b. Feldstein (2005) points out a similar "signalling" problem: unified monetary policy with decentralized fiscal policies creates a free riding problem, as spendthrift countries do not incur in market discipline through higher interest rates.

4) *loss of autonomy in fiscal policy* (De Grauwe, 1996): as Gandolfo (2002) points out, different models give rise to different results as far as the need for fiscal coordination is concerned. However, the argument listed above show that in the absence of fiscal discipline a monetary union may break down, as union membership may favour unsustainable paths of public spending in profligate countries. This stresses the need for the adoption of some binding rules. Nevertheless, an autonomous fiscal policy may be called for by the need to react to asymmetric shocks. Hence, although needed for the viability of the union, fiscal policy restraints may amplify the effect of shocks.

Before explaining the relation of this discussion with convergence and the CEMAC experience, it is useful to carefully analyze its theoretical foundations. As Gandolfo (2002) points out, some advantages emphasized by the "new" OCA theory are not completely "objective" or "neutral": they depend, instead, on the "the adhesion to a particular school of thought or to a particular (social) preference function". For this

[9] Gandolfo (2002) stresses that the answers depend also on the parameters of the social preference function.

[10] Tornell and Velasco (2001) examine this issue with reference to SSA countries and find that those belonging to monetary unions have delayed the fiscal adjustment needed in response to the adverse evolution of the terms of trade in the '80s.

purpose, it is useful to stress the fact that benefit number one (macroeconomic stability through reputation gains) rests on a relevant number of assumptions:

a) *inflation has only costs*, therefore the optimal inflation rate is the lowest attainable;
b) *the Phillips curve is vertical in the long- and possibly also in the short-run*, thereby implying that the *reduction* of inflation has no long- or short-run costs in terms of unemployment; this assumption rests in turn on two methodological assumptions:
    a. *representative agent models provide sound foundations to macroeconomic thinking*;
    b. *expectations are rational.*

While a thorough survey of the underlying debates clearly exceeds the scope of this study, we think nevertheless useful to recall that these assumptions are highly disputable, and to stress that what was taken for granted in developed economies in the '80s cannot be taken for granted anymore in the 21st century in developing countries, especially after the financial crisis. Failure to do so will lead to biased answers to the question on "why do we study convergence". It is therefore important to stress that:

a) as far as inflation is concerned, is important to remind that it has not only costs:
    a. every introductory macroeconomics textbook recalls that in presence of nominal rigidities and inefficiencies in the labour market, inflation plays a crucial role in the adjustment of the real wage;
    b. low inflation commitment are now questioned even by mainstream economists such as Blanchard *et al.* (2010), because they are conducive to liquidity traps, thus limiting the effectiveness of monetary policy in case of recessions; this implies that low inflation commitment may lead to increased output volatility;
    c. moreover, comparative studies (e.g., Khan and Senhadji, 2000) stress that although "single digit" inflation is a sensible goal, the threshold above which inflation lowers growth is nonlinear and considerably higher for developing than for developed countries.
b) as far as the "vertical Phillips curve" (hence, the no adjustment cost for reducing inflation) is concerned;
    a. the hypothesis of rational expectations upon which the vertical Phillips curve rests has not withstand empirical evidence in a number of occasions (Sumner, 1986; Lovell, 1986; Weizsacker, 2008);
    b. the representative agent framework within which the vertical Phillips curve result is obtained has been questioned as a reliable tool for macroeconomic analysis (Kirman, 1992), in particular because of observational equivalence problems stemming from aggregation (Lippi, 1988); as a consequence, long-run aggregate Phillips curve may not be vertical (hence, there can be long-run costs from reducing inflation) even in the presence of individual vertical Phillips curve (Hughes Hallet, 2000);
    c. at a more general level, Fuhrer (1995) tests the relevance of Lucas (1976) critique and finds the critique to be empirically irrelevant and the Phillips curve to be a structurally stable relation. *A priori* dismissal of the

inflation/unemployment appears therefore to be not grounded on empirical evidence.

What these critical remarks indicate is not that inflation convergence makes no sense from a theoretical point of view. Rather, these theoretical and empirical results stress that inflation convergence and/or a low inflation target may prove more costly, in the short and in the long run, than usually assumed in most statements by government or central bank officials (or economists such as Artis, 1991). Moreover, as far as CEMAC is concerned, these remarks point out the need of a more thorough investigation of structural features like the formation of expectations and the working of labour markets.
Coming now to the core of this study, under the "new" theory convergence comes into play in three different ways. First, the "credibility" argument implies that *inflation rates* will converge. Remark that inflation convergence now becomes an outcome, rather than a prerequisite, of OCA membership: in any case, it is still worth measuring, as the absence of convergence is likely to endanger the viability of the union. Second, convergence of *business cycles*, i.e., their synchronization, is also crucial for reducing the macroeconomic costs of union membership. Remark that even this kind of convergence can be seen as either a prerequisite, or an outcome, of OCA membership: this second view is taken by the so-called "endogenous OCA theory" of Frankel and Rose (1997), and depends strongly on the promotion of trade effect measured by Rose (2000). Third, while the old theory stressed the need of fiscal policy integration, the new theory stresses the need of convergence of some fiscal policy indicators to shared reference values, on sustainability grounds, in order to avoid free riding problems and the subsequent need to bail-out spendthrift countries. This kind of convergence is usually referred to as *macroeconomic policy convergence*.

The rationale for macroeconomic policy convergence will be discussed in depth in Section 3, while empirical tests of convergence will be surveyed in Section 4. Before doing that, we briefly survey the theoretical and empirical evidence on the optimality of CEMAC.

2.2 CEMAC an "old" or a "new" OCA (or neither)?

2.2.1 CEMAC and "old" OCA theory

There is a wide agreement that CEMAC is not an OCA in the sense of the "old" theory, because:

a) *interregional (i.e., intra-CEMAC) factor mobility is low*, as recognised for instance by UNECA (2008);
b) *product diversification is low*: a few primary products account for the largest share of exports in almost all CEMAC member country, and the overall trend is toward an increase in product specialization (see Fig. 1);
c) *the degree of openness varies but interregional trade is very low*: while some CEMAC countries ranks relatively high as far as the degree of openness is concerned (in 2004 Equatorial Guinea ranked 16th among 174 countries, with a trade-to-GDP ratio equal to 156%, close to that of Estonia or Ireland), other countries are relatively closed (Cameroon and Central

African Republic have trade-to-GDP ratio below 40%), and in any event the intra-regional trade is extremely low, at around 4% of total trade (UNECA, 2008). As far as inflation convergence is concerned, this implies that in order to avoid major trade disruptions, convergence towards the largest trading partner (i.e., the Euro area), is far more important than intra-regional convergence (i.e., convergence among CEMAC members). We will come to this point later, as it has generally went unnoticed in the applied literature.

d) *fiscal integration is low*, as documented for instance by UNECA (2008, chap. 5).

e) *inflation convergence has proven extremely low* in previous empirical analyses (UNECA, 2007), although, as we will see in more depth in Section 4 of this policy study, more recent econometric techniques shed a new light on this issue.

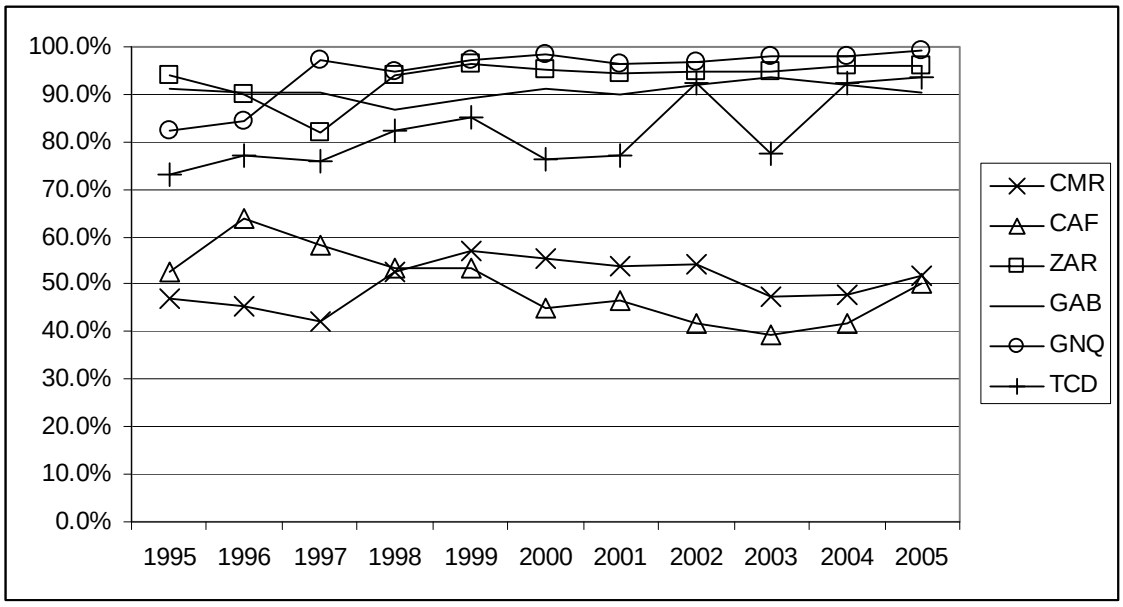

Fig. 1 – Product diversification: the share of the value of the first two largest product categories (typically crude oil or diamonds and timber) over total exports.

This prompts two further remarks. First, the fact that CEMAC is not an OCA in the "old" sense does not mean that "old" criteria are useless: on the contrary, they implicitly define an agenda of economic policy interventions that should be put in place in order to reduce the costs of membership for CEMAC countries. There is a widespread awareness of these issues and many of these developments are already under way and are summarised in UNECA (2008): among them we quote the removal of administrative barriers to the free circulation of CEMAC citizens (abolitions of visa obligations, etc.) and the improvement of transport infrastructures in order to foster intraregional trade. Moreover, although the importance of inflation convergence cannot be understated, it should be kept in mind that it is only one among many criteria. Second, the lack of an economic rationale for CEMAC suggests that political factors have been prevailing in its making. While this may seem obvious for CEMAC, as most of its member countries

have inherited union membership from their colonial history,[11] we should stress that nowadays there is wide agreement that political factors have been prevailing also in the making of CEMAC closest model and partner, namely, the EMU (see Baldwin, 2006).[12]

2.2.2 CEMAC and "new" OCA theory

It is sometimes asserted that "new" OCA theories provide a stronger economic rationale for monetary unions. In the case of CEMAC this view is held for instance by Bénassy-Quéré and Couper (2005) and Iossifov *et al.* (2009).

Macroeconomic stability vs. resilience to external shocks
According to the consensus view (e.g. Hadjimichael and Gali, 1997), the CFA Franc zone has performed relatively better than other SSA countries in terms of higher growth and lower inflation, at least from the beginning of the '50s to the mid '80s; then, adverse evolution of the terms of trade determined a loss of competitiveness and the situation worsened, also because the decision of devaluate was delayed until 1994, when CEMAC was established. The devaluation was followed by a burst of inflation, then growth resumed at an acceptable pace. On the basis of this evidence, Iossifov *et al.* (2009) conclude that CEMAC has reaped the benefits of macroeconomic stability derived from the monetary union membership (i.e., benefit (1) in Section 2.1.2).

Table 1 – CEMAC growth and oil prices

Dependent Variable: CEMAC growth
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CEMAC growth(-1)	0.535657	0.132575	4.040418	0.0003
OIL	0.031465	0.012020	2.617709	0.0131
Constant	0.012772	0.008286	1.541429	0.1325
R-squared	0.401633	Mean dependent var		0.040087
Adjusted R-squared	0.366435	S.D. dependent var		0.044824
Durbin-Watson stat	2.146071	Prob(F-statistic)		0.000162

Note: the model was estimated following a general-to-specific procedure starting from a parsimonious and data congruent AD(1,1) specification.

Data on CEMAC and other SSA countries real growth and inflation are depicted in Fig. 2 and 3. A quick look suggests a more cautious evaluation of the historical developments. First of all, the average growth rate of CEMAC from 1961 to 2006 has been 3.8%, only 0.4 points above the other SSA countries average growth (3.4%). It is true that in some instances CEMAC countries have largely outperformed SSA countries, but, as it is

[11] Equatorial Guinea adopted the CFA franc in 1984.

[12] Interestingly enough, perusal of the European newspaper of the '90s will show that before the inception of the EMU the decision of entering the monetary union has been advocated by politicians as a purely "technical" decision grounded on economic rationality. The fact that economic literature is adamant in attributing this decision to political considerations leaves one with the uneasy sensation that nobody in Europe (neither the politicians, nor the economists) is willing to endorse what has been the most important decision in the last four decades of European history. This is not a marginal question, as it raises the issue of how transparent (hence, democratic) has been the decision process related to EMU membership.

apparent in Fig. 2, this has happened in the aftermath of the two positive oil price shocks: after all, it is not surprising for oil exporting countries to perform better when oil price are rising (a similar argument is made by Fouda and Savastage, 1994). The simple correlation between oil price growth and CEMAC growth is 0.33 with a Student's *t* of 2.4, and oil price explain about 40% of the variance of CEMAC growth in a dynamic model estimated from 1970 through 2006, with a strongly significant coefficient (Table 1). What as not been observed to our knowledge is that the relation works also the other way around: when oil price fall, things go worse, and this may well explain while after the negative oil price shock following the collapse of OPEC in 1986 CEMAC largely *under*performed SSA countries.[13] Summing up, the impact of union membership on growth appears to be negligible. This result is not completely novel. Similar conclusions are reached for instance by Ben Hammouda *et al.* (2007) in their study of five regional economic communities in Africa. A different view is expressed by Anyanwu (2003): in a panel study considering 14 ECOWAS countries from 1990 to 2000 he finds that membership to WAEMU increases GDP per capita by ten times with respect to the other ECOWAS non-WAEMU countries.

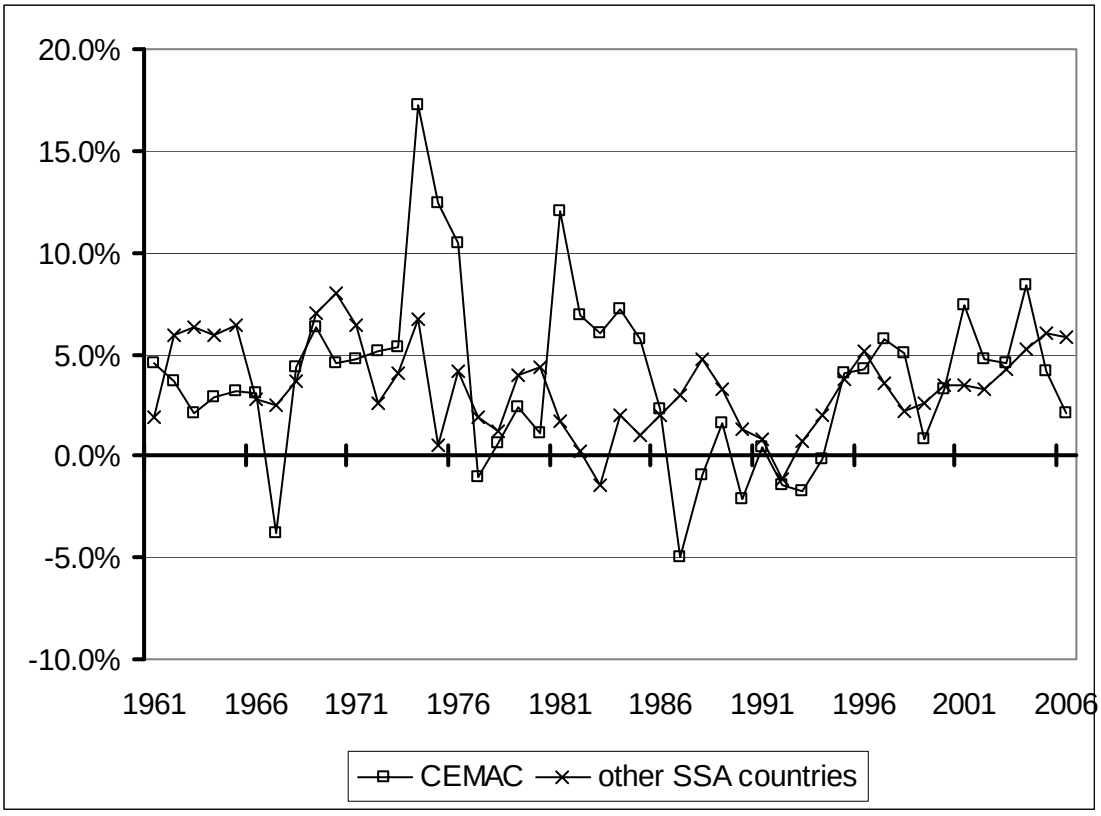

Fig. 2 – Real growth in CEMAC and in the other SSA countries (source: WDI, 2008).

What is indeed apparent from Fig. 2 is that CEMAC output *volatility* greatly outperformed that of other SSA countries: the coefficient of variation (ratio of sample standard deviation to sample average) of CEMAC growth rate is almost double, at 1.11, than that of the other SSA countries (equal to 0.65). This is consistent with cost (1) of

[13] If one controls for oil prices, the statistical relation between CEMAC aggregate growth and terms of trade variation vanishes.

Section 2.1.2, namely, with the amplification of (positive and negative) shocks due to the loss of monetary autonomy. A hint in this direction comes from the fact that the coefficient of variation of the other SSA oil exporting countries (which were potentially subject to the same kind of oil price shocks) is much lower than that of CEMAC.[14] Iossifov *et al.* (2009) suggest that the amplification of shocks could be determined by pro-cyclical fiscal policies (in the absence of monetary autonomy).

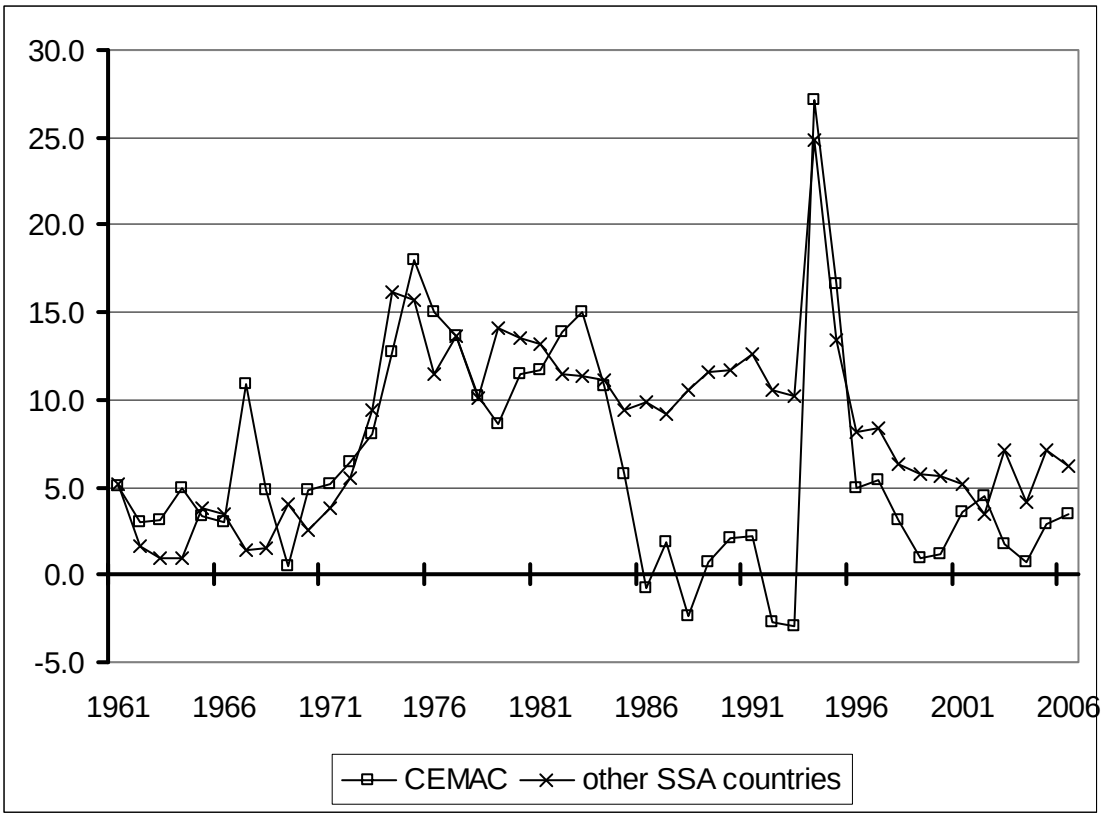

Fig. 3 – CPI inflation in CEMAC and in the other SSA countries (source: WDI, 2008). For the other SSA countries we took the median inflation rate.

The benefits of monetary stability are much more apparent when measured with reference to inflation. Average CPI inflation in CEMAC from 1961 through 2006 was equal to 6.18%, against an "other SSA" average of 8.43% (see Fig. 3).[15]
Even in this case, however, the data disclose some interesting patterns. Before 1986 CEMAC and "other SSA" inflation goes hand in hand, with a correlation of 0.80. Much of the advantage of CEMAC in terms of low inflation occurs in the aftermath of the negative oil price shock, when the CEMAC entered in a recession. The question is therefore why the other SSA (non oil) countries did not benefit of this shock in term

[14] The countries considered are Cote d'Ivoire, Kenya, Nigeria, South Africa, Sudan; the coefficient of variation of their output over 1961-2006 is equal to 0.68.
[15] The CEMAC inflation is a GDP-weighed average of national inflation rates; in the "other SSA" inflation is evaluated as the median of national CPI inflation rates. The reason why the median is used is that the GDP-weighed average of the "other SSA" countries would be severely affected by the burst of hyperinflation in Angola (inflation reached 4145% in 1996, and Angola accounts for a sizeable 3% to 4% of other SSA GDP): average "other SSA" inflation reaches 126% in 1996, with a contribution from Angola equal to 114% (i.e., Angola explained in that year 90% of "other SSA" inflation).

of lower imported inflation. A possible answer is that in the period from the mid '80s through the mid '90s a number of countries in SSA experienced periods of protracted hyperinflation mostly as a consequence of political instability.[16] Where the advantages become apparent is after 1994 (i.e., after the foundation of CEMAC): in the period from 1996 to 2006 average CPI inflation in other SSA countries has been twice as much (at 6.14%) that of CEMAC (at 2.94%), and the two inflation patterns have been decoupled (their correlation has halved, at 0.39).

Yet, in the absence of a more thorough analysis, it is unclear whether the data tell us that monetary unions deliver macroeconomic stability, or that for a developing country it is better not to run a civil war and to have sizeable reserves of crude oil. The two arguments could be tied together: after all, one benefit of economic and monetary integration could be that of favouring political integration, thus reducing the likelihood of conflict between member countries (an argument that has often been invoked with reference to economic and monetary integration in Europe).[17]

The "currency union effect" on trade and the "endogenous OCA hypothesis"

As far as the trade promotion effect of monetary union is concerned (advantage (2) in Section 1.2.1), this has been investigated by Anyanwu (2003) and Tsangarides *et al.* (2006, 2009) among others. Both studies exploit an augmented gravity model in the tradition of Rose (2000). As usual in this kind of studies, they find a very high impact of monetary union membership on trade. Anyanwu (2006) considers WAEMU countries and finds that they trade twice as much with each other than other Western African (ECOWAS) countries not sharing the CFA franc;[18] Tsangarides *et al.* (2006) finds a very similar result by considering all African countries and controlling for a number of other variables, including the colonial status of the country and the duration of monetary union membership. Tsangarides *et al.* (2006, 2009) are aware of Baldwin's (2006) criticisms to gravity models and take into account some of them; it is unclear however how they address the "treatment effect" issue pointed out by Persson (2001). We do not know of empirical evidence focussing specifically on the CEMAC experience. Taken at their face value, these encouraging results[19] would signal that CEMAC countries are undergoing an "endogenous OCA formation" process, where the promotion of trade determined by monetary union membership determines increased demand spillovers, that in turn determine a synchronization of economic cycles, thus reducing the macroeconomic costs of union membership. In terms of "convergence", these results thus imply that one should observe, besides high and growing interregional trade, "convergence" (in the meaning of progressive synchronization) of business cycles in CEMAC countries. We

[16] Average inflation from 1986 through 1993 was above 30% in Angola, Guinea-Bissau, Mozambique, Niger, Sierra Leone, Uganda and Zambia.

[17] Using much more sophisticated techniques, Elbadawi and Majd (1996) reach the same conclusion, namely, that CEMAC "failed to distinguish itself with regard to economic growth in the long run", although the CFA countries have performed better in terms of inflation.

[18] The WAEMU (Western Africa Economic and Monetary Union, also known as UEMOA, Union Economique et monétaire Ouest-Africaine) includes the CFA franc countries of Western Africa, namely Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. The ECOWAS (Economic Community of West African States) includes the UEMOA members and six more countries: Cape Verde, Gambia, Ghana, Liberia, Nigeria, Sierra Leone.

[19] Baldwin (2006) would probably call them "incredible".

have already seen that interregional trade in CEMAC is low, and we shall see in Section 4 that business cycle synchronization, if any, proceeds very slowly (to say the least).

It is important however to stress that these evidences (high "currency union effect", low "endogenous OCA" effect) are not necessarily conflicting. In fact, the "endogenous OCA/currency union effect" literature has generally overlooked two important economic facts, a theoretical one, and an empirical one. On the theoretical side, this literature ignores the fact that it is *net* exports, not exports *tout court*, that stimulate demand and growth. Since the "currency union effect" applies to each member country, it may well be that the increase in one country's exports is offset by the increase in other countries exports (to the extent that the latter are *imports* for the first country). The net effect (i.e., the increase in *net* exports of the first country) is therefore uncertain, as demand injections through the stimulus on exports may be more than compensated by demand leakages through increased imports.[20] By the way, this may explain why Anyanwu (2003) finds a negative effect of trade openness on per-capita GDP in ECOWAS countries: in fact, what matters for economic growth is not openness *per se*, but rather export growth (Hussain, 1999).[21] On the empirical side, the confidence on the fact that demand spillover may exert a significant impact in business cycles is at odd with what has been often found in macroeconometric simulations of multi-country models, namely, that "contributions to foreign GDP generated through trade are found to be small" (Douven and Peters, 1998). Remark that the fact that this result has been found with reference to OECD countries reinforces the case in point, because if trade spillovers are weak between countries whose trade relation are relatively strong, the same spillovers must be even weaker between countries whose trade connections are almost non existing (as CEMAC countries). This argument, while casting some doubt on the validity of the "endogenous OCA" hypothesis, has at the same time the merit of reconciling two apparently conflicting evidences.

The risk pooling/saving on exchange reserve argument

As Gandolfo (2002) points out, this is one of the more objective (i.e., less ideological) advantages of monetary union membership. Iossifov *et al.* (2009) provide evidence on this point, showing that the pooled reserve of the CEMAC zone provide a better coverage in months of imports than the reserve of each single country (with the possible exception of Equatorial Guinea).

External vs. internal monetary stability: the euro peg and fear of floating

Bénassy-Quéré and Couper (2005) point out another important feature of monetary unions in SSA (including CEMAC), one that is overlooked by OCA theory, as this was "mainly designed for industrial countries". In fact, we have seen that while their intraregional trade is low, CEMAC countries are relatively open, with trade-to-GDP ratios in a range from 40% to 156%. Unsurprisingly enough, their major trade partner is the euro area, which accounts for about 40% of CEMAC exports and 60% of CEMAC imports. In this respect, the peg to the euro may well be more important for member

[20] On the relevance of this argument for African economies see for instance Thirlwall (2000).

[21] By the way, one may wonder whether the "miraculous" effect of monetary union on per capita GDP in Anyanwu (2003) regression would resist after controlling for export growth.

countries than the simple fact of sharing the same currency: "high indebtedness and pass-through may twist the choice towards pegs on international currencies". This reminds the "fear of floating" literature initiated by Calvo and Reinhardt (2000), where debt servicing difficulties, the likelihood of severe current account reversals, difficulties to credit market access, and higher pass-through from exchange rate swings to domestic inflations advise developing countries to "confine exchange rate movement to a narrow band". In this respect, it is useful to remind that four out of the six CEMAC countries have either qualified (Cameroon, Central African Republic) or are eligible to (Chad, Democratic Republic of the Congo) the Highly Indebted Poor Countries (HIPC) joint initiative of the IMF and the World Bank.

Moreover, this implies that convergence of CEMAC inflation to euro area inflation is far more important, as far as current account sustainability is concerned, than convergence of member countries inflations with each other, a point that has been overlooked in most empirical analyses. A positive inflation differential with the euro zone will bring about a real appreciation of the CFA franc towards the euro. We remember that real appreciation of the CFA franc is often quoted as the main reason of CEMAC countries recession between 1986 and 1994 (though we have seen that the adverse course of oil price may have contributed to this recession).

Political considerations

Although some of the argument listed above provide an economic rationale to CEMAC membership, it is now widely recognised that the main motivation for CEMAC were political (see e.g. Masson and Pattillo, 2005).

Pushing this argument further, Iossifov *et al.* (2009) argue that the "revealed preferences" of the political establishment shows that the benefits of CEMAC have prevailed over the costs (thus implicitly validating it as an OCA). However, in the CEMAC as elsewhere, for this argument to be convincing, one should be able to assume that the political establishment has come to power by virtue of a democratic process and is able to withstand to pressure from lobbies, so that its preferences reflect that of the majority of the constituency, thus assuring that the benefits are shared by a large share of the population. The governance indicators of Kaufmann *et al.* (2008), however, show that CEMAC countries are placed very low in the "voice and accountability" ranking,[22] and even lower in the "control of corruption" ranking.[23] In our view, therefore, the "establishment revealed preference" argument cannot be taken seriously, unless one is willing to take up the issue of whom preferences are revealed, and to put this in the right political economy perspective.

At a more general level, the literature on OCAs very often evocates "political factors" as something of completely exogenous to the economic functioning of a country. However,

[22] Defined as "the government's preparedness to be externally accountable through citizen feedback and democratic institutions, and a competitive press".

[23] The percentage ranks of CEMAC countries goes from 4% (Equatorial Guinea) to 22% (Central African Republic) in the "voice and accountability ranking", and from 2% (Equatorial Guinea) to 21% (Gabon) in the "control of corruption" ranking. Limiting the analysis to SSA countries does not improve significantly the situation, as all CEMAC countries rank below the median.

asserting that something has been done "for political reasons" does not mean that the underlying decision was not motivated by the economic interests of some subject. Monetary unions, like every economic fact, are no free lunches.

2.2.3 Convergence and optimality

The debate on the optimality of CEMAC is still open and will probably never be settled, because, as for any other monetary union, the answer depends on the preference function used for weighing benefits against costs (a point carefully stressed by Gandolfo (2002)). However, the previous discussion help us to put in perspective the study of convergence: we are now able to answer to the "what" and "why" questions. Basically, convergence in inflation rates is an essential condition for avoiding current account crises within the union (or with the major trading partner, in case of peg to an external hard currency), and convergence (better saying, synchronization) of economic cycles is both a test of the endogenous OCA hypothesis, and a condition for minimizing the costs determined by the loss of autonomy of the monetary (and fiscal) policy in the presence of uncorrelated external shocks.

OCA theory does not consider convergence of GDP (per capita) levels or growth rates.

The "how" question will be answered in Section 4, but before doing that we need to investigate more in depth the issue of macroeconomic policy convergence and its implementation in multilateral surveillance agreements.

3. Macroeconomic policy convergence: the sense and nonsense of multilateral surveillance agreements

3.1 Fiscal policy coordination and convergence in a monetary union

In an EMU-like monetary union monetary policy has by definition "converged", as it is entrusted to a supranational central bank. The issue then arises of whether national fiscal policies should be coordinated. Macroeconomic policy *coordination* refers to whether or not national policy maker shall take into account the impact of their decisions on the other member countries in the design of national economic policies.[24] When fiscal coordination is defined (or enforced) by setting specific targets on fiscal policy variables, we obtain as a special case fiscal policy *convergence*. This definition is based on the presumption that fiscal policy will be coordinated if fiscal policy variables converge to the specified targets.

The case for fiscal policy coordination predates the inception of EMU. Fischer (1987) states it very clearly: "any one country that expands will create a current account deficit; all countries expanding together avoid that problem". In a monetary union, the focus is on avoiding the externalities (macroeconomic spillovers) created by possibly unsustainable fiscal policies in member countries.

[24] Technically speaking, coordination is mostly represented as a policy game where each national government takes into account other countries' output in its objective function.

As it happens, the need for fiscal policy *convergence* is presented as a self-evident fact of nature in most of the applied literature, including that related to CEMAC (e.g., Iossifov *et al.*, 2009). A careful analysis of the theoretical and empirical literature shows however that the case for fiscal policy *coordination* is not undisputed, that the assumption that *convergence* will bring about coordination is questionable, and that the choice of the convergence parameters and of the enforcement rules is open to discussion.[25]

As for the first point, some authors question the view that fiscal externalities must be internalized through supranational rules. Buiter *et al.* (1993) and Buiter (2006) distinguish between two classes of externalities: those determined by unsustainable fiscal policies, and those determined by sustainable fiscal policies. As for the first ones, since national economic stability is in the self-interest of every national government, Buiter (2006) argues that a credible "no bail-out" clause will impose a sufficient restraint on national fiscal programmes, unless one assumes irrationality of national governments (with the associated need of paternalistic policies at supranational level). Moreover, it is argued that financial market will discipline sovereign borrowers by imposing risk premia on the public debt of the more spendthrift countries (Bayoumi *et al.*, 1995). Therefore, once monetary financing of deficit is prohibited, this will dissuade national policy makers to engage on unsustainable deficit paths. Feldstein (2005) argues however that centralized monetary policy prevents the working of market discipline. As for the macroeconomic spillovers that can occur without violating the sustainability of national policies, the literature has insisted on cross-border effect determined by the impact of national policies on union-wide nominal and real risk-free interest rates. Their empirical relevance has been assessed for instance by Douven and Peters (1998) and Faini (2006) and generally found to be non negligible.[26] However, many authors stress that this kind of externality is actually a "pecuniary" externality, determined by the normal functioning of the price mechanism through the law of supply and demand. In complete competitive markets these externalities have no adverse consequences on efficiency: they only have distributional consequences (between debtors and creditors), but unless markets are distorted, there is no need for government interventions (Buiter, 2006). By the way, as Hau (2006) points out, the same kind of externalities occurs through the functioning of private credit markets, without raising the same concerns. The presumption that governments need "peer-pressure" because of their intrinsic irresponsibility should be confronted with the evidence of the huge private defaults recorded in the last decade. Another strand of literature analyses the welfare enhancing effect of fiscal policy coordination in a monetary union, reaching mixed results.[27] Given this conflicting evidence, we can conclude with Gandolfo (2002) that in a monetary union "the case for fiscal-policy coordination is less cogent than that for a common monetary policy".
Assuming however that some coordination is needed, we come to the issue as to whether "convergence" to exogenously set parameters ensures "coordination". Buiter (2006), referring to the convergence rules of the Stability and Growth Pact (SGP), states that

[25] As usual, the literature refers mostly to the EMU. In what follows, it should be kept in mind that although the structure of the CEMAC agreement mimics many feature of the EMU, there are still relevant differences, that we will point out in due course.
[26] For instance, Douven and Peters (1998), while founding that trade-induced GDP spillovers are negligible (thus invalidating the "endogenous OCA" hypothesis of GDP "synchronization" through increased trade), at the same time
[27] The early results of this literature are reviewed in Gandolfo (2002, par. 20.4), the recent results in Ferré (2002)

"the SGP is completely useless as a policy coordination device. It influences and constrains each individual without any reference to economic conditions in other countries". This determines a logical inconsistency: this design of the convergence parameters would make sense only if there were no cross-border spillovers, but in the absence of such spillovers, there would be no need for "supranational surveillance". As Ferré (2008) points out, "narrow" coordination, where each country looks only at national variables, brings about higher volatility of interest rates, government deficits and output, thus undermining the long-run growth of the union.[28]

As for the third point, namely, the choice of the convergence parameters, Maastricht-like deficit and debt criteria have been heavily criticized since the very beginning of the EMU convergence process, and the recent revision of the SGP has proven that some of these criticisms were right. The most heated criticisms come from Pasinetti (1998) and Buiter (2006). According to Buiter, Maastricht convergence parameters are "arbitrary and neither necessary nor sufficient for national financial-fiscal sustainability", they "prevent the normal operation of automatic stabilisers" and are "asymmetric". Moreover, it is "truly strange" to fine a country for excessive deficit, thereby worsening its fiscal position.

3.2 Coordination and convergence in CEMAC countries: market discipline vs. "agency of restraints"

The previous discussion refers almost exclusively to the EMU experience. Although the CFA franc zone (hence, the CEMAC) has important similarities with the EMU (as stressed for instance by Strauss-Kahn, 2002), there are also important differences, both in the structure of the respective economies, and in the institutions of the monetary unions, that suggests that some arguments set out above do not apply directly to CEMAC countries.

Iossifov *et al.* (2009) point out two specific reasons that call for supranational coordination of fiscal policy in the CEMAC: first, the capital markets in the region are still "in their infancy". As a consequence, the "market discipline" argument cannot be applied to these countries. Second, the statute of BEAC limits, but does not prohibit, monetary financing of public deficit. As a consequence, there is the risk of free riding behaviour by national government, with possible inflationary consequences.

The need for supranational convergence criteria is stressed also by Obinyeluaku and Viegi (2009). Using a panel of 20 African countries, they find evidence that the conduct of economic in Africa is compatible with a "fiscal dominant regime", as defined by Canzoneri and Diba (1996). In a "fiscal dominant regime" the price level cannot be determined independently of the government's present value borrowing constraint. As a consequence, the central bank lacks the necessary autonomy to warrant price stability. Canzoneri and Diba (1996) show that the enforcement of a deficit criterion would ensure a monetary dominant regime. Therefore, the results by Obinyeluaku and Viegi (2009) suggest that in African countries monetary union without a surveillance programme

[28] Ramey and Ramey (1995) find that government spending induced volatility depresses growth in a sample of 95 countries.

cannot provide an "agency of restraint" that prevents unsustainable or inflationary fiscal policy patterns.[29]

The same point has been made by Masson and Pattillo (2001, 2004). They stress that in Africa institutional challenges, and in particular the pressure by fiscal authorities on national central banks, have historically been much greater than in Europe. As a consequence, it is doubtful that the creation of a regional central bank *per se* can solve the credibility problems of the existing national central banks: in order to exert a greater discipline on fiscal authorities than national central banks, a regional central bank must be supported by other institutional features. As an example, Masson and Pattillo (2004) refer to CEMAC. In their views, the experience of CEMAC countries shows that monetary union *per se* is not associated with a noticeable increase in policy coordination. A greater effort in this direction has been spurred by the crisis of the early '90s, after which a new supranational institution has been created.

A convincing argument in favour of the need of binding rules is set out by Tornell and Velasco (1991). Focussing on SSA countries experience during the '80s, they find evidence that flexible exchange rates provide more fiscal discipline than fixed exchange rate. Fixed exchange rate regime does adversely affect the degree of fiscal adjustment even after controlling for a number of macroeconomic variables, such as the variation in the terms of trade, and the initial values of GDP per capita and debt-to-GDP ratio. The theoretical explanation is that fixed exchange rate allow the policy makers to delay the costs of adjustment. As a consequence, countries belonging to a monetary union need some additional constraint on fiscal variables.

Summing up, the previous discussion lends some support to the assumption that CEMAC countries may need a supranational binding constraint on fiscal policy, possibly in the form of a "Maastricht-like" set of fiscal convergence criteria. It must be stressed, however, that unlike the SGP, the CEMAC treaty does not envisage a binding enforcement strategy like the Excessive Deficit Procedure (EDP) defined by Maastricht treaty.[30] It must be noticed, however, that the EDP was never enforced, probably because the first two countries to breach the deficit threshold were Germany and France. In the light of this historical experience, the lack of an incisive enforcement procedure of the surveillance framework in the CEMAC is less harmful in practice than it can appear in theory. The specification of strict rules could result in a loss of credibility, should it become apparent that nobody will follow them. After all, even in the EMU "peer pressure" is the only enforcement mechanism.[31]

---

[29] It is therefore fair to stress that upon closer scrutiny Canzoneri and Diba (1999) reversed their opinion about the usefulness of the SGP.

[30] The procedure to adopt when a member country does not comply with the multilateral surveillance framework is set out in the articles 58 to 61 of the "Convention régissant l'Unione Economique d'Afrique Centrale (UEAC)", an annex to the CEMAC Treaty signed in March 1994. The definition of excessive deficit is given by the article 55. A deficit is deemed to be excessive if it is incompatible with the monetary policy objectives, or if it is accompanied by the violation of one of the following surveillance criteria: positive primary balance, non accumulation of domestic and external arrears, non increase of the ratio between the public wage bill and government receipts. The 2001 revision of the multilateral surveillance has led to the adoption of quantitative targets (see Par. 3.4 below).

[31] The failure to enforce the procedure against the two dominant powers of the EMU brought about the 2005 revision of the SGP, in which the EDP is substantially weakened (Buiter, 2006). No fines have ever been imposed for excessive deficits.

3.3 Fiscal sustainability and fiscal convergence

The rationale for setting deficit or debt ceilings is the need to avoid adverse macroeconomic spillovers determined by unsustainable fiscal policies in member countries. In this section we briefly set out the relations between "Maastricht-like" ceilings and public debt sustainability. This analysis is crucial for evaluating the consistency of the convergence parameters chosen. We list here some remarks in decreasing order of generality.

First of all, it is useful to remind that the economic theory has not reached an agreement on a definition of "public debt sustainability" both rigorous and operational (see Chalk and Hemming, 2000, Bagnai, 2004). In other words, any reference to "sustainability" when defining convergence parameters is *necessarily* sloppy for lack of an agreed upon and rigorous theoretical benchmark.

Second, if one relies on definition of sustainability grounded on the public sector *solvency* constraint, then every constant value of the debt-to-GDP ratio, as well as any exponentially *growing* pattern of this ratio, provided that its growth rate is smaller than the spread between the real interest and growth rates, shall be considered sustainable (see Appendix). This is the reason why Buiter (2006) states that the SGP fiscal convergence parameters are not necessary for "national financial-fiscal sustainability".

Third, if one instead identifies sustainability with a constant value of the debt-to-GDP ratio, then the standard approach, based on the government budget identity, stipulates that in the presence of positive nominal growth rates *any* value of the deficit-to-GDP ratio will be sustainable (as it will eventually lead to a constant steady-state value of the debt-to-GDP ratio). For the "dynamic stability" approach to provide non trivial answers, one must apply it to a dynamic model of the whole economy (not to a single identity), as done for instance by Bagnai (1995). This raises the issue, systematically neglected in the applied literature, of the optimal level of public debt. Most studies on convergence assume implicitly that the optimal value of the debt is zero (a similar treatment is reserved to the optimal inflation rate). However, this is not what the theoretical literature says (see for instance Zee, 1988). Clearly, in the absence of a thorough theoretical and empirical analysis of the issue of "public debt optimality", any "Maastricht-like" threshold will be open to Buiter (2006) criticism of arbitrariness.

Fourth, simple debt arithmetic implies that the two thresholds on debt and deficit are tied in the long run by a simple relation:

$$\bar{d} = \frac{(1+\gamma)\bar{f}}{\gamma}$$

where $\bar{d}$ is the "convergence" value of the public debt-to-GDP ratio, $\bar{f}$ the "convergence" value of the public deficit-to-GDP ratio, and γ the long-run nominal growth rate (see the Appendix).[32] This raises several issues of consistency. By defining the two values of $\bar{d}$ and $\bar{f}$, one is actually defining (implicitly) a value for γ that may, or may not, be consistent with the structure of the economy. Moreover, since γ is generally

[32] Remark that in what follows we will refer to government deficit, instead of government balance, as do the CEMAC surveillance rules. This is because

outside the control of the policy maker, there is no general presumption that it will be such as to reconcile the two target values $\bar{d}$ and $\bar{f}$. This implies that in practice one of the two convergence criteria will become irrelevant. This is precisely what happened in the convergence to EMU, where the debt criterion was actually discarded and only the deficit criterion was enforced.[33] The previous statement must be qualified: in fact, there is a particular case in which the two values of $\bar{d}$ and $\bar{f}$ are mutually consistent *for every value of* γ. This happens when $\bar{f}=0$, which implies $\bar{d}=0$ irrespective of γ.

3.4 Fiscal convergence in CEMAC countries

Coming to the CEMAC, after the 2001 refinement the two fiscal criteria are defined as follows:

1) the basic fiscal balance must be non negative;
2) the ratio of the domestic and external public debt to GDP must be less than 70%.

The deficit rule reminds the SGP recommendation for "medium-term objectives of budgetary positions close to balance or in surplus". There are however important differences. As a matter of fact, the SGP recommendation of a non negative balance must be seen in the framework of the Maastricht parameters: the reference parameter for the deficit-to-GDP ratio is still 3%. The ≤0% rule is a recommended medium-term objective that should provide a country with enough fiscal flexibility, thus allowing it to react to adverse shocks without breaching the 3% ceiling (Artis and Buti, 2000). In the CEMAC surveillance programme, on the contrary, 0% is *the* parameter and there is no reference to the medium term: in principle, the ≤0% deficit rule must be satisfied each and every year. The CEMAC deficit parameter appears therefore much more stringent than that envisaged by the EMU.[34] Yet, it is true that some flexibility is allowed by the escape clauses, that are much less strict than the European ones.[35] At the same time, the debt criterion is much less stringent, especially if one considers that a 0% deficit-to-GDP ratio implies a 0% debt-to-GDP ratio in the long run.

The coexistence of a strict deficit criterion with a lax debt criterion causes at least two problems. First, there is a problem of credibility and enforcement of the deficit rule, which is made worse by the way in which flexibility is provided (namely, with the "flexible" application of "rigid" parameters).[36] Second, a lax debt criterion is tantamount to no debt criterion at all: however, since the sustainability of fiscal policies depends

[33] An explicit reference to "debt sustainability" was added in the 2005 revision of the SGP.
[34] A similar concern is stressed by Iossifov *et al.* (2009).
[35] In the first version of the SGP the Excessive Deficit Procedure was not applied automatically if a country had had an annual growth less than -0.75%, and was not applied at all in case of growth less than -2%. The 2005 revision extends the non-automatic application of the sanctions to every situation of negative growth, and even to a "protracted period of very low annual GDP volume growth relative to its potential". Moreover, the period for implementing the corrective actions is extended from two to four years (Alves and Afonso, 2007). The Article 58 of the CEMAC Treaty establishes that the CEMAC Council may exempt a country from complying with the multilateral surveillance procedure in case of "difficulties or serious threats of difficulties", and this exemption can be renewed after six months. The decisions must be taken unanimously. The "difficulties" however are not quantified.
[36] The European experience is pertinent also in this case.

essentially on the stock of public debt. In other words, this set of rules undermines fiscal flexibility without properly addressing the issue of sustainability.[37]

In fact, the CEMAC deficit criterion may be less restrictive than it appears, as it refers to "basic fiscal balance", defined as total revenue net of grants ("hors dons") and total expenditure net of foreign-financed capital expenditures. Let S^B be the basic balance, S^G be the overall balance (hence, $S^G=-F$), R total revenue, E total expenditures, G grants and I^F foreign-financed capital expenditures. We then have:
$S^B = R-G-(E-I^F)$
and, considering that $S^G = R - E$, we obtain:
$S^G-S^B = G - I^F$

These relations imply that when the *basic* balance is equal to zero, the *overall* balance (which determines debt accumulation) will be equal to the difference between grants and foreign-financed capital expenditures. As shown in Table 2, this difference has averaged −0.7 GDP points on the whole CEMAC area in the first twelve years of CEMAC, i.e., foreign-financed public investment has on average exceeded grants. The foreign-financed public investment has been on average equal to 1.7 GDP points. In other words, in practice the "basic balance" rule allows for a positive overall deficit. However, the size of this deficit is not large enough to restore consistency with the debt criterion.

Given that the average nominal growth rate has been equal to 12%, it then follows that the steady state level of the public debt-to-GDP ratio is equal to about 0.007/0.12=6%; if we take a more prudential stance and do not take into account the grants in the overall balance, the steady-state debt ratio rises to 0.017/0.12=14%, which is still very low in comparison with the 70% parameter and with the historical experience.[38] Put it in another way, a debt criterion at 70% under a nominal growth rate at 12% is consistent with a steady state overall deficit at 7.5%, hence with a basic balance at around −6% of GDP.[39] Hence, even after accounting for the difference between basic and overall balance, the inconsistence between the two criteria remains striking. This suggest that in order to restore consistency, either the debt criterion must become more stringent, or the deficit criterion less stringent, or both.

[37] The idea that macroeconomic convergence parameters should be defined in terms of debt, rather than deficit, ceilings has been put forward by Pisani-Ferry (2004). A reference to debt "sustainability" has been added to the revised SGP of 2005, but it is unclear what relevance will this reference have in practice.
[38] UNECA (2007) considers slightly different numerical values.
[39] The steady state deficit is equal to $\bar{f} = \frac{\gamma \bar{d}}{1+\gamma}$.

Table 2 – Basic balance and overall balance

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	average
S^B	-4.8	-1.1	0.2	-0.2	-4.7	0.4	5.3	2.9	2.1	4.4	4.9	9.0	1.5
S^G	-5.6	-2.1	-0.8	-1.3	-5.5	-0.3	4.6	2.4	1.6	4.0	4.1	8.7	0.8
$G\text{-}I^F$	-0.8	-1.0	-1.0	-1.1	-0.9	-0.8	-0.6	-0.6	-0.5	-0.3	-0.8	-0.3	-0.7
I^F	2.3	2.1	1.8	1.9	1.8	1.5	1.6	1.5	1.4	1.4	1.7	1.0	1.7
γ	29.9	11.7	13.6	9.2	-2.1	9.8	21.4	5.1	5.8	4.5	11.6	24.4	12.1

This discussion prompts several further remarks.

First, rather than adopting vague escape clauses, another (and perhaps better) way to introduce flexibility (thereby avoiding "fiscal overkill" in case of major external shocks), would be that of defining the deficit criterion in terms of "structural" budget balance.[40] In fact, the "basic structural budget balance" is already considered among the "second rank" criteria, where the "cyclical" features of the ordinary balance are removed by taking a five years moving average of oil revenues. UNECA (2007) proposes that the main surveillance criterion be formulated in terms of "structural basic balance". At the same time, UNECA (2007) points out that the measure of structural balance currently adopted purges the cyclical component only from receipts. This is unwarranted, because total expenditures have been on average at least as volatile as total receipts (the standard deviation of the total expenditures-to-GDP ratio over 1987-2006 id equal to 3.5, that of total receipts to 3.5; see Fig. 4); moreover, total expenditures have shown a strong anti-cyclical behaviour (their simple correlation coefficient with GDP nominal growth rate is equal to -0.7 over the same sample).

[40] An emphasis on "structural" balances is also built in the SGP revision (European Council, 2005)

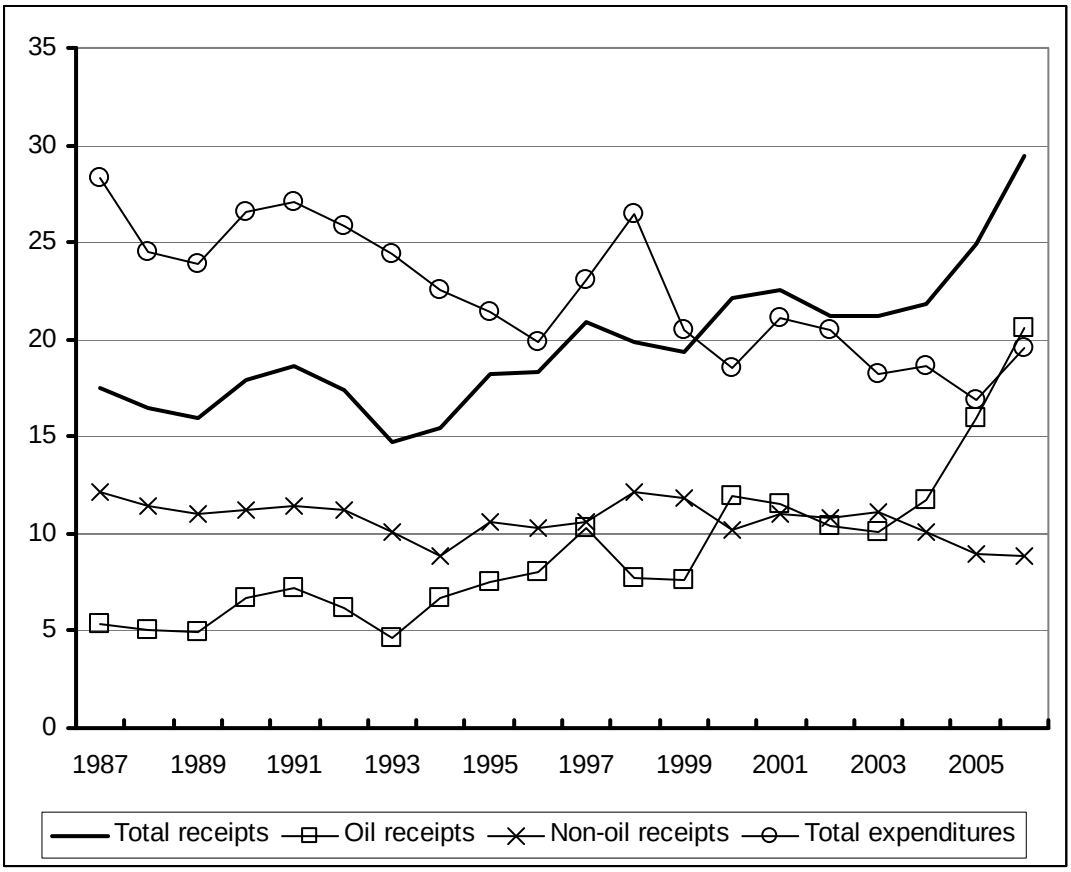

Fig. 4 – Government total receipts, oil receipts, non oil receipts and total expenditures in CEMAC as a share of GDP.

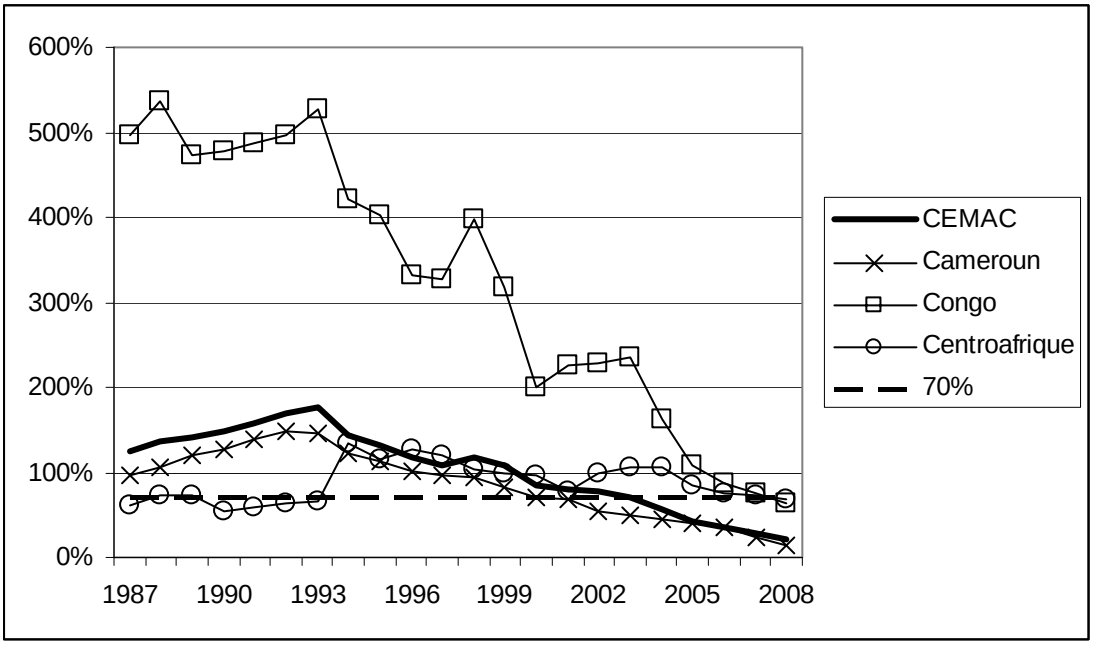

Fig. 5 – Overall (domestic and external) public debt over GDP in selected CEMAC countries.

Another important feature to consider is the role of oil receipts in public debt dynamics. Figure 5 shows the path of the overall (domestic and external) public debt-to-GDP ratio in selected CEMAC countries: we have taken the whole area, Cameroon (which is the largest country, accounting for about a half of CEMAC GDP),[41] and the two countries that did not comply with the debt criterion in 2006.[42] The overall picture is that of an impressive achievement in the reduction of the debt-to-GDP ratio after the devaluation and the establishment of CEMAC in 1994: in 2008 every CEMAC country complied with the 70% criterion. In principle, this suggests an optimistic view about public debt sustainability and the working of the surveillance programme. There are however some caveats, one concerning the level, and the other the volatility of the public debt-to-GDP ratio.

As far as the level is concerned, it must be noticed that this impressive performance is mostly attributable to oil revenues. A very rough measure of the contribution of oil revenues to debt reduction is given by the cumulated sum of oil revenues as a share of GDP: at the CEMAC level, this is equal to about 130 GDP points from 1995 to 2006, thus explaining the about 110 GDP points reduction in the debt-to-GDP ratio over the same period. In fact, the reduction of the debt-to-GDP ratio has been more painful and less firm in the only non-oil country of CEMAC, namely, the Central African Republic.

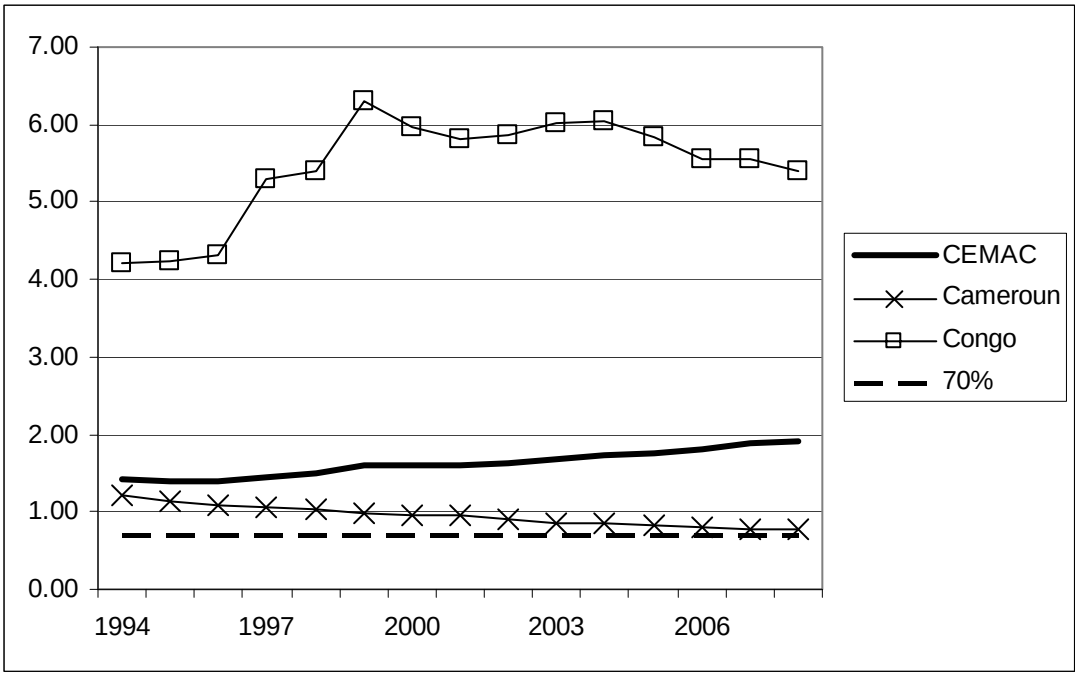

Fig. 6 – The path of overall (domestic and external) public debt over GDP in selected CEMAC countries in the absence of oil revenues (source: author calculations).

Fig. 6 shows the results of a counterfactual simulations where the path of public debt is simulated starting from the initial condition in 1994 onwards, in the absence of oil sector. In other words, we have simulated Eq. (5) in App. 6.1 by removing oil receipts from f_t

[41] The share of Cameroon over CEMAC GDP is actually falling, mostly due to the buoyant expansion of Equatorial Guinea.

[42] The data for 2001-2006 come from UNECA (2007), the data for 2008 come from UNECA (2009), the data from 1987 to 2000 have been retropolated using the debt accumulation equation, which implies that $d_{t-1} = (1+\gamma_t)(d_t - f_t)$. f_t is the overall budget balance and γ_t the nominal growth rate (source: BEAC).

and taking as γ_t the non-oil nominal GDP growth.[43] Unsurprisingly enough, the results are much less comforting. Take for instance the case of Congo. If oil receipts and GDP are taken into account, the average deficit-to-GDP ratio and nominal GDP growth over 1994-2008 are -1% (implying an average surplus) and 15% respectively, which taken together imply a steady state debt ratio of -7%. However, the non oil deficit and nominal growth are 47% and 8%, which implies a steady state debt ratio of about 585%. The simulation suggests that in the absence of oil receipts the situation would have further worsened on average after 1994. In particular, the debt at the CEMAC level would converge to a steady state close to 190%, resulting from the ratio of an average non-oil deficit close to 11% with a non-oil long-run nominal growth close to 6%.

As far as the volatility of the debt-to-GDP ratio is concerned, it must be stressed that the behaviour of any ratio is strongly and nonlinearly affected by that of its denominator. Since CEMAC growth is extremely volatile (Fig. 2), some episodes of sharp drop in the debt-to-GDP ratio may be determined by a burst of high (inflationary) growth. However, a reversal of this growth may lead to a rapid worsening of the situation: episodes of this kind are apparent in the case of Congo (Fig. 5). This suggests a more prudential attitude in "good times".[44]

Given the windfall character of oil revenues, their eventual exhaustion in the medium- to long-run, and their dependence on factors completely outside the control of CEMAC policy makers (the largely unexplained variations in the price of crude oil), these very crude simulations point out the need of considering the non-oil basic budget balance as a more reliable indicator of fiscal sustainability.[45] This is suggested by UNECA (2007) and strongly advocated by Iossifov *et al.* (2009). In fact, after the 2008 revision of the surveillance framework, a non negative non-oil basic budget is taken into account among the secondary (i.e., non mandatory) convergence criteria. As stressed in the last convergence report by UNECA (2009), the evolution of this indicator shows the persistence of structural fragilities in CEMAC oil economies.

Taking stock of this discussion, a possible synthesis could be that of defining the reference parameter in terms of a value of the (possibly structural) non-oil basic balance *consistent with the 70% parameter*. This would automatically allow any windfall oil revenues to be devoted to "fiscal consolidation". The current "second rank" criterion, namely, that the non-oil basic budget as a percentage of non-oil GDP must be non negative, appears however unnecessarily restrictive.

[43] There are some evident limitations in this "what-if" approach: for instance, we assume that the non-oil GDP would be the same in the presence and in the absence of the oil sector, and we take as initial condition the ratio of debt to overall (instead of non-oil) GDP. The first of these limitations, however, may be less serious than it appears, because it is widely recognized that in CEMAC countries the oil sector is relatively insulated from the non-oil one (see for instance Iossifov *et al.*, 2009).

[44] A recommendation which is also stressed by the European SGP.

[45] It must be stressed that the performance shown in Fig. 5 has received momentum by a decade of protracted rise in oil prices.

Table 3 – Selected CEMAC fiscal indicators

	Nominal growth rate	Nominal non-oil growth rate	Overall non-oil deficit over GDP	Overall non-oil deficit over non-oil GDP	Overall-basic balance spread
1995	11.7%	13.5%	10.8%	13.2%	2.1%
1996	13.6%	9.2%	9.6%	12.2%	1.8%
1997	9.2%	8.5%	12.4%	16.0%	1.9%
1998	-2.1%	7.5%	14.2%	16.7%	1.8%
1999	9.8%	1.4%	8.7%	11.0%	1.5%
2000	21.4%	7.2%	8.3%	11.9%	1.6%
2001	5.1%	10.2%	10.2%	13.9%	1.5%
2002	5.8%	6.4%	9.7%	13.2%	1.4%
2003	4.5%	3.9%	7.1%	9.7%	1.4%
2004	11.6%	4.8%	8.6%	12.4%	1.7%
2005	24.4%	6.1%	7.9%	13.5%	1.0%
2006	11.7%	8.1%	10.7%	18.8%	1.0%
average	**10.6%**	**7.2%**	**9.9%**	**13.5%**	**1.6%**

The variables in Table 3 allow us to evaluate some alternative proposal. The average nominal growth ratio over1995-2006 has been 10.6% for total GDP and 7.2% for non-oil GDP.[46] In the same sample, average non-oil total deficit has been equal to 9.9 GDP points and to 13.5 non-oil GDP points. Taking first as a benchmark total GDP, which makes sense, because the debt target is defined with reference to total GDP,[47] the steady state debt ratio implied the non-oil deficit and the total growth rate is 9.9%/10.6%=93%; if instead we take non-oil growth, the steady state debt raises to 9.9%/7.2%=136%; finally, if we consider the ratio of overall non-oil deficit over non-oil GDP, the ratio rises further to 13.5%/7.2%=187%. Even in the most favourable case we obtain a value well in excess of the 70% ceiling.

By applying the steady state deficit formula

$$\bar{f} = \frac{\gamma \bar{d}}{1+\gamma}$$

and rounding up the results to integers, if we take as reference the total growth rate, we get a convergence value of 7% for the non-oil deficit, corresponding to about 5% for the basic non-oil deficit (given the average spread between these two balances). If instead we adopt a more prudential stance and we use non-oil growth rate, the convergence value drops to 5% for non-oil deficit and to 3% for non-oil basic deficit respectively.

Figure 7 simulates the effect of the 5% non-oil basic deficit rule on CEMAC debt convergence. It must be stressed that this simulation probably overstates the effects of fiscal consolidation, because it is performed by iterating forward the debt accumulation

[46] The beginning of the sample coincides with the first year since the inception of CEMAC. We dropped 1994 because it features an exceptional burst of inflation due to the devaluation. The end of the sample coincides with the last year for which we have reliable data. However, omitting the crisis years makes sense, as we are here interested in steady state reference values.

[47] We note on passing that if what matters is the sign of the non-oil balance, as it appears from the surveillance rule, the denominator of the ratio does not matter, as neither the non-oil nor the total GDP are ever expected to be negative. In what follows, however, the difference between total and non-oil GDP matters, the obvious implication being that if we refer to non-oil GDP we get more stringent convergence parameters.

equation from 1994 onwards imposing the respect of the 5% rule but leaving the growth rates unchanged. Since the average non-oil basic deficit from 1994 onwards has been equal to 9% on average, the 5% rule imposes a −4 GDP points correction on total deficit. This restrictive fiscal measure would likely determine a downward revision of the growth rates, hence, an upward revision of the debt path. Keeping this in mind, the results are rather telling: even the (apparently) lax 5% basic non-oil deficit fiscal rule would have determined a much quicker fiscal consolidation. If we adopt the rather extreme hypothesis that the restrictive measure would halve the nominal growth rate, the results do not change a lot: the debt-to-GDP ratio converges to zero in 2008.

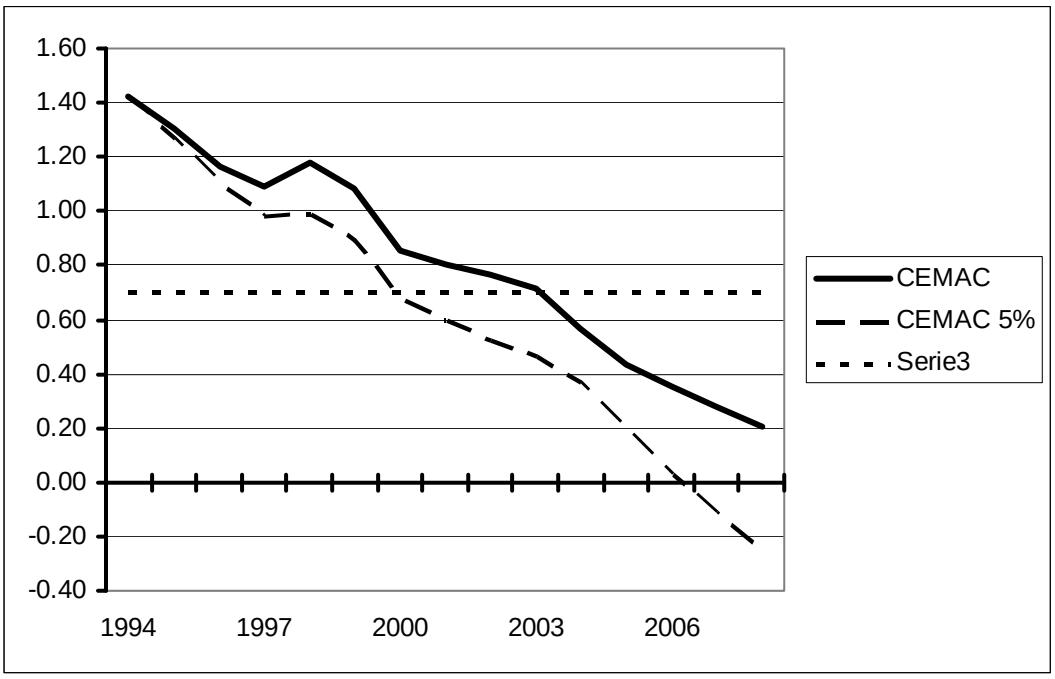

Fig. 7 – The path of overall (domestic and external) public debt over GDP at the CEMAC level: actual values, and simulation of a 5% basic non-oil deficit rule.

These results show that the zero non-oil basic balance rule is probably too restrictive.[48] Sensible value of the convergence parameters must be selected keeping in mind the consistency between the long-run (or steady state) values of debt and deficit, under reasonable assumption on the long-run nominal growth path. In this respect, one should remember that developing countries are likely to show higher real and nominal growth rates than developed ones. As a consequence, fiscal targets that closely mimic SGP zero balance rules make little sense in the context of developing economies.

4. Assessing macroeconomic convergence: methods and applications to CEMAC countries

Unsurprisingly enough, the study of macroeconomic convergence received a great momentum from the building of EMU, both at the theoretical and methodological level. In fact, the reference study for the definition of macroeconomic convergence, namely

[48] By the way, the fact that this rule is not mandatory exacerbates the problem of its credibility.

Hall *et al.* (1997), deals with the issue of monetary policy convergence in the European Monetary System (EMS), the forerunner of EMU.

As we shall see, the empirical analysis of convergence leaves a lot of scope for further research: not all the available methods have yet been applied, the methods that have been applied are not always the most appropriate, and the interpretation of their results is not always convincing. There are at least two historical reasons for this.

The first one is that the interest for the empirical assessment of convergence in the meaning of OCA theory follows the adoption of Maastricht treaty, but previous studies of convergence had dealt with convergence in "growth-theoretical" sense, i.e., cross-country convergence of GDP per capita level as result of a catching-up process. Remark that such a convergence is completely ignored by OCA theory, for the simple reason that it is fully irrelevant to the viability of a monetary union. Due to technical progress, GDP per capita is a non stationary variable. The two variables whose convergence is relevant under OCA theory, i.e., inflation and the business cycle, are instead stationary. This may have lead to some misunderstanding.

The second one is that most of the literature on economic convergence in Europe precedes the inception of the euro in 1999 and was therefore concerned with the sustainability of the EMS and the likelihood of its safe conversion into the EMU. Remark that at that time monetary authorities, though committed to convergence by Maastricht treaty, preserved their autonomy. Therefore, it made a lot of sense to test whether they were actually complying with their commitment to "converge". However, the one-to-one translation of these tests to a full-fledged and long-established monetary union as CEMAC makes little sense, as in this context monetary authorities have by definition surrendered their autonomy to a supranational bank.

In this Section we will first set out the operational definitions of convergence, and then move to a survey of the main empirical results related to CEMAC.

4.1 Operational definitions of convergence

In this subsection we sketch the operational definitions of convergence that have been proposed in the literature, in order to put in perspective the empirical results presented later. As the literature on "convergence" in a broad sense (i.e., including "growth theoretical" convergence) is huge, we will focus only on the definitions of convergence that are (or could be) relevant to the studies performed in CEMAC countries. The analysis carried out in Section 2 has shown that according to OCA theory two concepts of "convergence" are relevant: the convergence of inflation rates of member countries to a unique value, and the synchrony of the business cycle among member countries. Let us consider these two concepts in turn.

4.1.1 Convergence among economic variables

σ-*convergence*

Probably the simplest tool to investigate the convergence among a set of variables consists in investigating the time pattern of a measure of dispersion of their distribution. In the growth literature, this goes under the name of σ–convergence (σ being the usual symbol for the standard deviation). σ–convergence, although appealing as a descriptive tool, presents two unsatisfactory features: first, unless the variance converges exactly to zero (i.e., unless the two series coincide in the limit, which of course is extremely unlikely for two economic series), the σ criterion does not inform us on the sign of the spreads among the variables; second, a formal test of convergence (i.e., a formal test on the size of σ) can be obtained only under very restrictive distributional assumptions (Hall *et al.*, 1997). The first issue is not trivial, because as far as the viability of a monetary union is concerned, a relatively large inflation differential whose sign changes often is less dangerous than a comparatively smaller inflation differential whose sign persists.

Table 4 - σ-convergence in the EMU

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	average
AUT	*0.5*	2.0	2.3	1.7	1.3	2.0	2.1	1.7	2.2	3.2	1.9
BEL	1.1	2.7	2.4	1.6	1.5	1.9	2.5	2.3	1.8	**4.5**	2.2
CYP	1.1	4.9	2.0	2.8	4.0	1.9	2.0	2.2	2.2	4.4	2.7
FIN	1.3	3.0	2.7	2.0	1.3	*0.1*	*0.8*	*1.3*	1.6	3.9	1.8
FRA	0.6	1.8	*1.8*	1.9	2.2	2.3	1.9	1.9	1.6	3.2	1.9
DEU	0.6	*1.4*	1.9	*1.4*	*1.0*	1.8	1.9	1.8	2.3	2.8	1.7
ITA	1.7	2.6	2.3	2.6	2.8	2.3	2.2	2.2	2.0	3.5	2.4
LUX	1.0	3.2	2.7	2.1	2.0	2.2	2.5	2.7	2.3	3.4	2.4
NLD	2.0	2.3	**5.1**	3.8	2.2	1.4	1.5	1.7	*1.6*	*2.2*	2.4
PRT	2.2	2.8	4.4	3.7	3.3	2.5	2.1	3.0	2.4	2.7	2.9
IRL	**2.5**	**5.3**	4.0	**4.7**	**4.0**	2.3	2.2	2.7	2.9	3.1	3.4
GRC	2.1	2.9	3.7	3.9	3.4	3.0	**3.5**	3.3	**3.0**	4.2	3.3
ESP	2.2	3.5	2.8	3.6	3.1	**3.1**	3.4	**3.6**	2.8	4.1	3.2
σ	0.7	1.1	1.0	1.1	1.0	0.7	0.7	0.7	0.5	0.7	0.8
spread	2.0	3.9	3.3	3.4	3.0	2.9	2.7	2.3	1.4	2.3	2.7

Note: in each year the largest inflation value is highlighted in **bold**, the smallest in *italic*. σ is the cross-country sample standard deviation, spread is the spread between the largest and the smallest inflation value in each year.

Table 5 - σ-convergence in the CEMAC

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	average
CMR	3.1	0.8	4.5	2.8	0.6	0.3	1.9	5.1	1.1	*5.3*	2.6
RCA	-1.5	3.1	3.8	2.3	4.2	-2.1	2.9	6.6	1.0	**9.3**	3.0
TCD	*-8.0*	3.8	**12.4**	5.2	*-1.8*	*-5.3*	**7.9**	**8.1**	*-7.4*	8.3	2.3
CNG	**3.6**	*0.5*	*0.8*	3.1	-1.3	3.6	2.5	4.7	2.5	*5.3*	2.5
GBN	-0.7	*0.5*	2.1	*0.2*	2.3	0.4	*-0.2*	*4.0*	4.8	*5.3*	1.9
GNQ	0.6	**4.6**	8.8	**7.6**	**7.3**	**4.2**	5.0	5.0	**5.5**	6.0	5.5
σ	4.2	1.8	4.4	2.6	3.5	3.6	2.8	1.5	4.6	1.8	3.1
spread	11.6	4.1	11.6	7.4	9.1	9.5	8.1	4.1	12.9	4	8.2

Note: in each year the largest inflation value is highlighted in **bold**, the smallest in *italic*. σ is the cross-country sample standard deviation, spread is the spread between the largest and the smallest inflation value in each year.

The recent European experiences illustrates the latter case: the average largest inflation differential in the EMU from 1999 to 2008 has been equal on average to 2.7 points, which is small in comparison of the average size of the largest inflation differential in the CEMAC in the same period, equal to 8.2 points (see Table 4 and 5).[49] However, in the EMU the comparatively smaller inflation differential, being persistent, have led to a loss of competitiveness and to a current account crisis in a number of peripheral economies. In fact, if we take the twelve inflation differentials with the dominant country (Germany), we see that their sign is reversed in only 18 cases (corresponding to 15% of the sample); on the contrary, if we take the inflation differentials between CEMAC countries and Cameroon (the largest CEMAC economy), the reversals of sign are much more frequent, reaching 46% of the available observations. However, despite the evident occurrence of a crisis, the standard deviation of the inflation rates in the EMU is smaller, less volatile, and downward sloped, i.e., it exhibits σ–convergence, whereas CEMAC inflation rates do not (see Fig. 8).

[49] The average largest inflation differential is calculated by averaging over the differentials among the highest and lowest inflation country in each year. We exclude from this calculation Malta, Slovenia and the Slovak Republic, that joined the EMU only recently

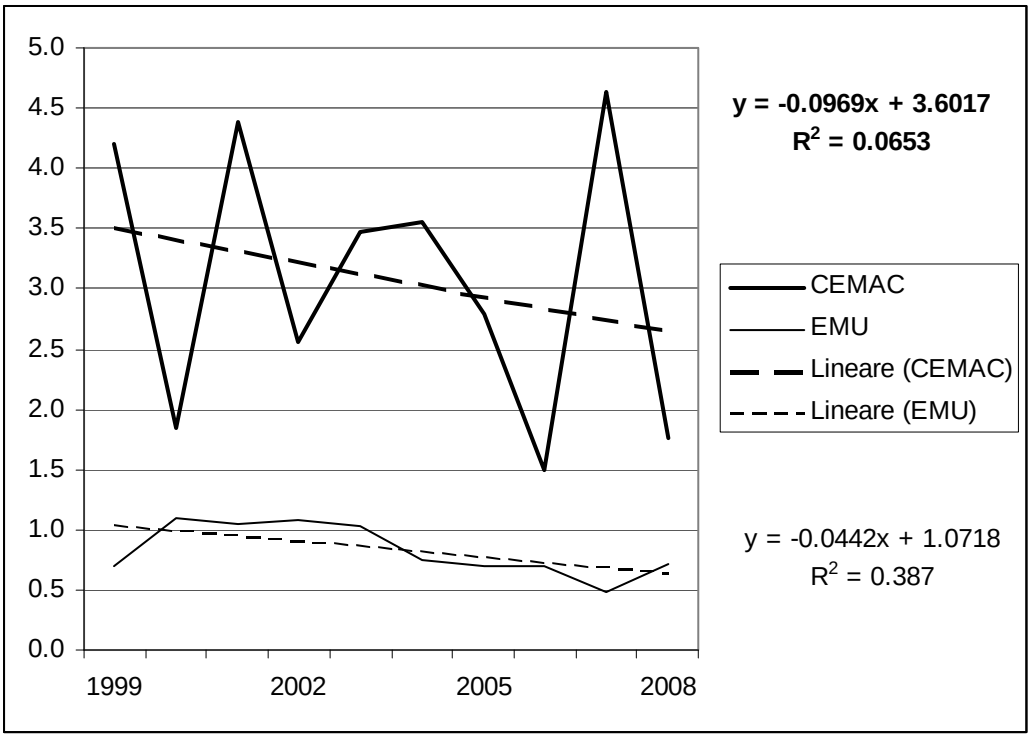

Fig. 8 – σ-convergence in CEMAC and in the EMU. The graph represents the patterns of the cross-country standard deviation of inflation in CEMAC (bold line) and in the EMU. The EMU standard deviations show a significant downward trend (the linear trend explains about 39% of their variance). On the contrary, the interpolation of the linear trend to the CEMAC standard deviations results in an insignificant regression, with an R^2 of only 0.06.

Definitions of convergence based on time series analysis

As convergence is intrinsically a dynamic process, and a long-run one, its empirical study has drawn extensively on the modern literature on long-run time series analysis, based on the concept of cointegration. According to the definition originally proposed by Engle and Granger (1987), two non stationary time series are said to be cointegrated if they do not drift far apart in the long run. This definition can be extended to any number *n* of time series. When two or more time series are cointegrated, their long-run behaviour is explained by one (or more) common stochastic trend.

As shown in Appendix 7.3, the application of modern time series analysis to the assessment of convergence has lead to two different approaches: the first one, proposed by Hall *et al.* (1997) following Bernard and Durlauf (1995), broadly speaking identifies convergence with cointegration. This opens to two shortcomings: the first one is that cointegration is a property of the whole time series, while convergence may occur toward the end of the sample, for instance because of a structural change. In other words, cointegration tells us that the variables have always moved together, which is a different concept from convergence, that occurs when variables move increasingly close to each other. Cointegration is therefore too strong a condition for convergence. Another shortcoming derives from the fact that cointegration, by its very nature, requires that the time series involved are non stationary: for two time series to have a common trend, they first must display a trending behaviour. This restricts the applicability of the convergence

assessment to trending series. While this is not a big limitations on "growth-theoretical" convergence, that actually deals with trending series such as per capita GDP, it becomes a serious drawback in the assessment of "OCA-theoretical" convergence, because, as set out before, in this strand of literature the only variable whose convergence matters is the inflation rate, that is not expected to feature a trend in the long run.

This two limitations are removed by Andrew Harvey and his co-authors (Busetti *et al.*, 2006), who propose an original approach for testing convergence among the levels and the growth rates of a set of time series. The logic of this approach, which rests on simple stationarity and non-stationarity tests, is expounded in Appendix 7.3 and an application to CEMAC inflation rates is given in Section 4.3 below.

4.1.2 Convergence" of economic cycles

As explained above, the "convergence" (i.e., synchronization) of economic cycles warrants that a common monetary policy will not harm any member economy in the presence of a common external shock. A related, but distinct, issue is that of verifying whether the shocks hitting the member economies are on average symmetric or asymmetric, because in the presence of "symmetric" shocks a "symmetric" (i.e., common) policy answer would not undermine growth in member countries (irrespective of their cyclical position). UNECA (2007) defines this as the "shock convergence" issue. Of course, the best situation is that where both the cycles and the shocks are synchronized.

Cycles synchronization

Frequency domain econometrics provides with a number of sophisticated methods for investigating the synchronization of the cyclical components of a given time series, for instance by examining the coherency spectrum of two series (see Harvey, 1990). There are however two important limitations: first, spectral analysis is extremely data intensive, it requires long time series of possibly quarterly or monthly data, a requirement that is impossible to satisfy in some cases (among which, the case of CEMAC); second, the analysis in the frequency domain cancels the information in the time domain (Iacobucci, 2003). We have seen, however, that convergence is by definition an asymptotic process, i.e., one in which time matters.[50]

For this reason, the synchronization of economic cycles has been studied mainly in the time domain, by examining the correlations among the cyclical components of each country GDP, after removing the trend component by means of *ad hoc* methods like the Hodrick-Prescott filter.

"Symmetry" of shocks

As stated before, by symmetric shocks we mean shocks of the same sign and/or hitting all the regions of the currency area. The first studies in this area looked at the correlation

[50] The time-frequency domain analysis based on evolutionary spectral analysis and wavelets methods is much more data demanding and has known only a limited number of applications in economics, mostly in the domain of finance, where large datasets are available (Jouini, 2009).

of business cycles or at the volatility of bilateral real exchange rates between each pair of countries (de Grauwe and Vanhaverbeke, 1991). As stressed by Bénassy-Quéré and Coupet (2005), this approach "did not assess the degree of symmetry of the shocks, but rather the degree of asymmetry of the results of the shocks, including economic policy reaction". These studies failed to identify the shocks, by mixing them up with the cycles, and failed to identify the nature of the shocks (i.e., whether supply or demand shocks, real or monetary shocks), although the modern theory of OCAs suggests that the optimality of a given exchange rate regime is strongly dependent on the nature of the shocks (Gandolfo, 2002).

In order to cope with these issues, Bayoumi and Eichengreen (1993) propose to apply Blanchard and Quah (1993) decomposition of shocks between supply and demand side based on a VAR model. This methodology (or suitable variants of it) has been applied to countries in SSA by Fielding and Shields (2001), Buigut and Valev (2007), UNECA (2007). It should be noted that the identification of the shocks proceeds from very restrictive *a priori* on the structure of an economic system. On the other hand, this literature does usually *not* provide any evidence about the statistical congruency of the underlying VAR model with the data (no tests on the residuals are provided, the choice of lags is often undocumented, the structural stability of the coefficients is not tested, and so on). Since shocks are after all an empirical matter, some more information about the reliability of the empirical models would be reassuring (to say the least).

4.2 Assessing convergence in the CEMAC: a survey of the empirical literature

The most recent and extended study of macroeconomic convergence in CEMAC is UNECA (2007), that also provide a survey of some previous empirical studies in SSA and the CFA franc zone. This important study stresses both the strength and the weaknesses of some methodological developments surveyed above. As far as convergence among variables is concerned, UNECA (2007) refers to MacDonald and Taylor (1991) and apply Johansen (1988) maximum likelihood cointegration estimator, that allows the researcher to verify the number of stationary linear combinations among a set of N variables. UNECA (2007) considers the six CEMAC countries. Accordingly, the hypothesis that the variables share the same stochastic trend (i.e., "converge") is identified with the presence of five stable linear combinations (cointegrating relations).[51] More precisely, this procedure envisages two polar cases: if there are zero cointegrating relations, this implies that there are N stochastic trends in the data: in other words, each variables evolves along an independent stochastic trend, with no relations to the other variables; if there are N stable linear combinations, this means that the data are stationary (hence, there is no trend at all in the data). In the intermediate cases, the presence of $M<N$ linear combinations implies that the data are lead by N-M stochastic trends: "full convergence" obtains when $M=N$-1, otherwise we have cases of "partial convergence", where the data may follow more than one attractor. In principle, this suggests the possible presence of convergence clubs, but it is unclear how the methodology can lead to the identification of such clubs.

[51] When Sao Tomé and Principe is included along with the CEMAC countries the number of countries raises to 7, and the hypothesis of "full" convergence coincides with the presence of 6 cointegrating relationships.

Several features of UNECA (2007) are worth noting. First, the choice of variables. Convergence is tested on almost everything, ranging from money stock to government budget balance. Yet, as stressed above, the theory of OCA lends little support for the study of convergence of most of these variables. In fact, the only convergence explicitly considered by OCA theory is that of inflation rates. As stressed before, the tests on the money stock performed by Hafer and Kutan (1994) made sense, because they referred to EMS, not to EMU. For the EMS to be viable the formally autonomous national monetary policies had to be tied by cointegration. In a monetary union like CEMAC, where monetary policy is already managed by a supranational central bank, the test results are obviously uninformative about the opportunity of entering the monetary union! As far as the fiscal variables are concerned, there is little theoretical support for identifying "cointegration" with "fiscal policy convergence". To our knowledge, no theoretical model of fiscal policy coordination imposes long-run cointegrating restrictions on the behaviour of fiscal variables across countries. One could also wonder whether it is a good idea to impose "uniformity" of fiscal policies in a region that is characterized by a sizeable degree of shock asymmetry, as shown in UNECA (2007). At a more general level, no theoretical model suggest that monetary union membership will bring about GDP convergence, i.e., will boost the growth of poor economies *proportionately more* than that of rich economies, thus inducing a *catch-up* process. The argument that European economic integration has brought about convergence among member countries should be qualified, because there is no obvious mean for empirically discriminate between "spontaneous" convergence (the catch-up envisaged by standard growth theory) and "integration-induced" convergence. In this light, the fact that the results show non convergence among GDP levels is neither particularly surprising nor informative. Moreover, the authors attribute this result to the huge differences in size among CEMAC member countries. However, this argument applies to fiscal variables as well. A possible solution would be that of scaling the fiscal variables with each country's GDP, and to consider GDP per capita instead of GDP, as is usual in the growth theoretic convergence literature. Considering the GDP per capita, as usual in the growth literature does not substantially alter the picture. Moreover, Iossifov *et al.* (2009) points out that total government receipts are strongly and jointly affected by oil price dynamics, hence a study of their cointegration makes little sense, because it likely indicates joint dependence on a variable outside the control of the policy makers, rather than "convergence" in the design of policies.

Second, exclusive reliance on the cointegration approach leads to paradoxical results. The more disturbing is the omission of trend stationary variables. These are omitted on the basis of the fact that they do not fit within the framework of the Johansen estimator. However, their exclusion limits the relevance of the analysis. Consider for instance the two trend stationary series represented in Fig. 9. The strict adherence to the "cointegration-convergence" paradigm would exclude these series from the analysis, as they are $I(0)$ (with trend). However, their trends are obviously converging. How useful is a theoretical framework that cannot deals with such cases? As recalled above, Hall *et al.* (1996) warns strongly against the identification of convergence with cointegration, stating that the latter is neither necessary nor sufficient for the former. Consider for instance the two series represented in Fig. 10. They are independent random walk, hence non cointegrated by construction. Would you also say that they are not converging?

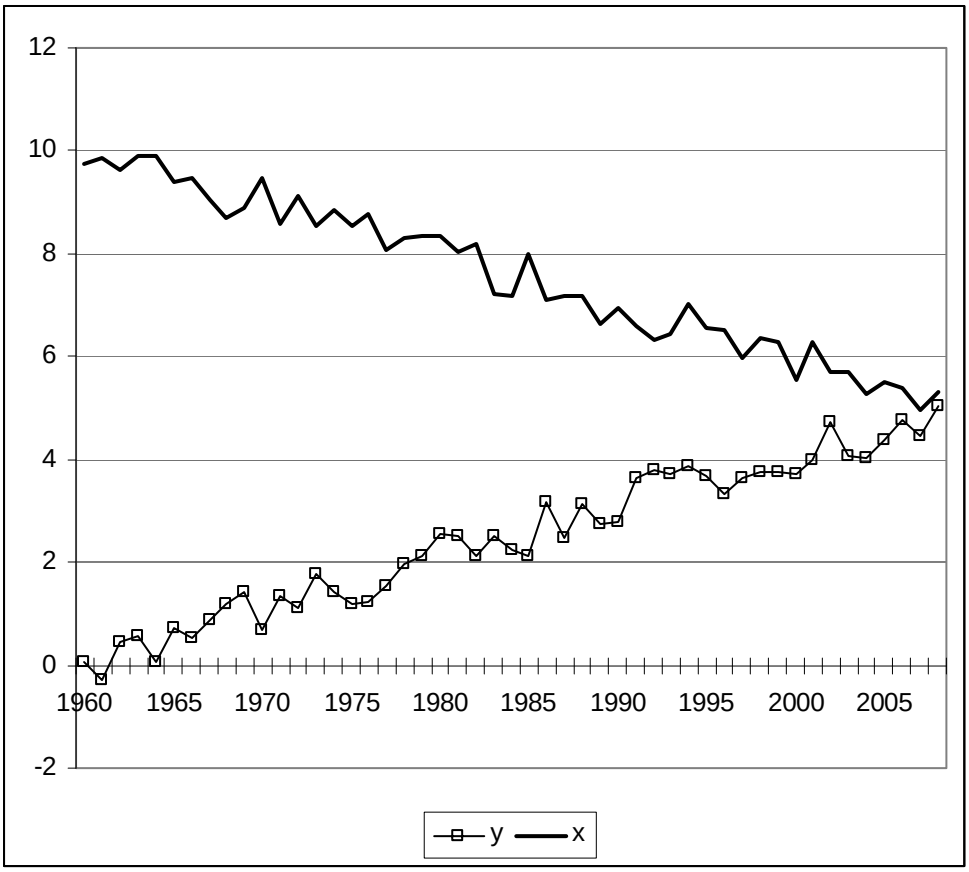

Fig. 9 – The realization of two trend stationary processes.

Of course these critics need some qualification. For instance, in Fig. 9 and 10 convergence may be only apparent. The series in Fig. 9 are expected to continue along their paths, hence to diverge from the end of the sample onwards, while the behaviour of the series in Fig. 10 is by construction unpredictable. They are however warnings against an uncritical application of statistical techniques.

Another questionable feature of UNECA (2007) is the way in which price convergence is analysed. As far as inflation rates are concerned, UNECA (2007) considers only their σ-convergence and finds them to be converging (however, the discussion above warns against the usefulness of σ-convergence). When it comes to prices, UNECA (2007) asserts that if there are *N*-1 cointegrating relations among *N* price variables, price differentials will vanish. Let us check this assertion for 2 price series, $P_{i,t}$ and $P_{j,t}$. Cointegration requires that there is a stable linear relationship of this kind

$ln\ P_{i,t} = \beta_0 + \beta_1 lnP_{j,t} + u_t$

Now, if $\beta_0 \neq 0$ and $\beta_1 \neq 1$, this relation does actually imply a persistent price differential between *i* and *j* (remember Hall's *et al.* (1997) remark that "sensible convergence would require θ=1", or Bernard and Durlauf (1995) definition of convergence). By differencing the long-run relation above, omitting the stochastic terms, we obtain

$\Delta ln\ P_{i,t} = \beta_1 \Delta lnP_{j,t}$

Hence, cointegration of prices, *per se*, does not imply either the price or the inflation differential will vanish. By the way, as pointed out by Busetti *et al.* (2006), *absolute* convergence makes no sense when considering price indices. UNECA (2007) provides no information whatever about the size of the coefficients in the cointegrating relations.

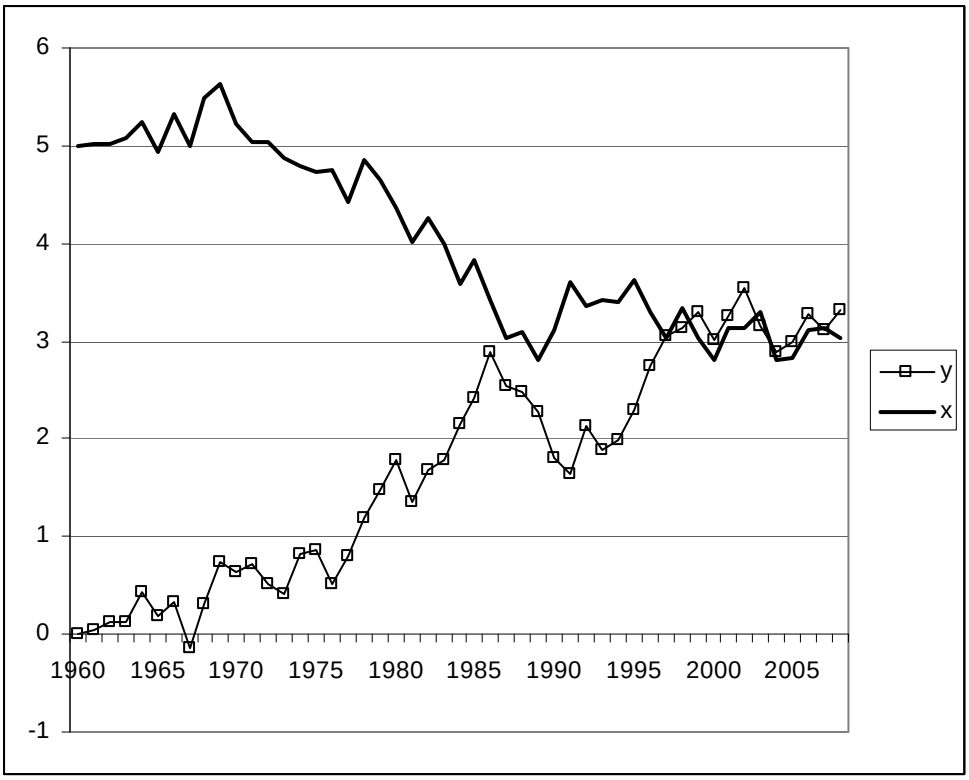

Fig. 10 – The realization of two independent random walks.

Besides this critiques, maximum likelihood (ML) cointegration techniques rests on a number of statistical assumptions that are unverified and in most cases extremely unlikely. Just to make an example, ML assumes that the underlying data generating process is stable. This is likely to be an untenable assumption in a set of countries like CEMAC, that underwent a major devaluation (not to say other shocks).

4.3 Price convergence between in CEMAC countries

We now provide an alternative analysis of price convergence in the CEMAC based on the framework of Busetti *et al.* (2007), that appears to be more informative, as it takes explicitly into account the difference between price and inflation convergence, and the difference between convergence and stability (thus allowing the researcher to discriminate the cases when two series have already converged from those in which they are converging).

4.3.1 The CEMAC and the euro area

We start from the analysis of price convergence between CEMAC and the EMU. As European countries account for a large share of CEMAC trade, while interregional trade is almost inexistent, the convergence to European prices does matter much more than

the interregional convergence of prices, as far as the external equilibrium of CEMAC countries is concerned.
The time series of consumer prices in CEMAC and in the EU-12 region are reported in Fig. 11. It is apparent that they have deviate starting in the mid '80s, and that the 1994 devaluation has brought CEMAC prices back on track with the European ones.

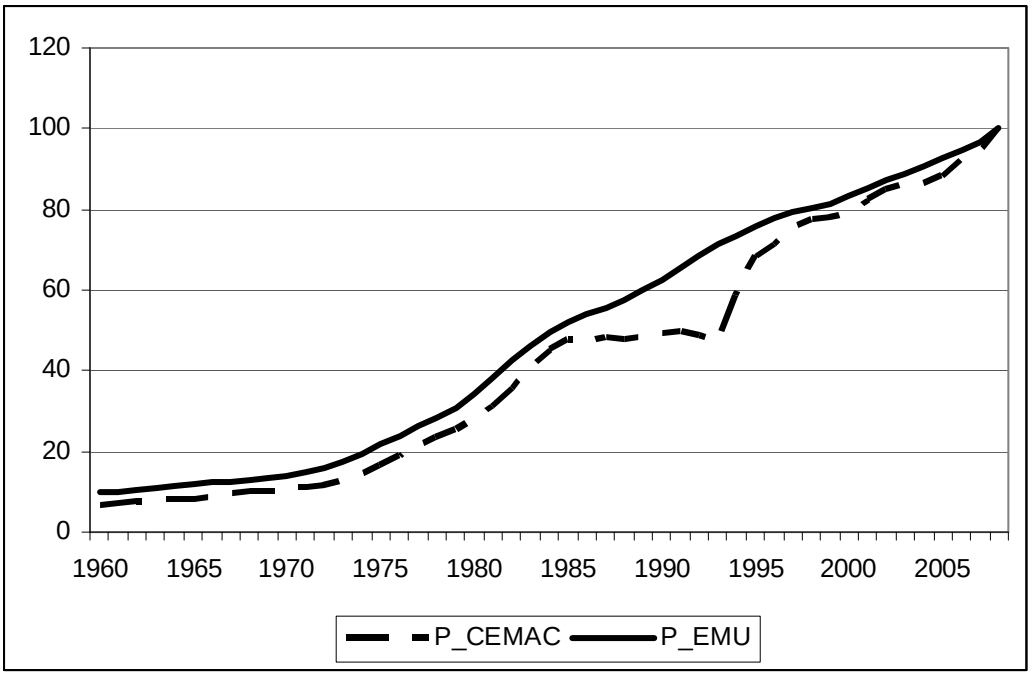

Fig. 11 – Consumption price indices in CEMAC and in the EMU.

Table 6 – Tests of inflation convergence between CEMAC and EMU

Hypothesis	*statistics*	*result*
non convergence in inflation rates (τ_0)	-4.76	reject
non convergence in level (τ^*)	-1.49	accept
stability of inflation differentials (ξ_0)	0.04	accept

Following Busetti *et al.* (2006) strategy, we begin by testing the non stationarity of the inflation differential. The hypothesis is rejected by the ADF test. We analyse the hypothesis of non stationarity of price levels: this hypothesis is accepted, hence no convergence in levels is under way. We move then to the analysis of the stationarity of the price differentials: the hypothesis is accepted, which means that there has been convergence in inflation rates between CEMAC and the EMU.

4.3.2 Convergence among the CEMAC regions

The number of inflation differentials among N regions equals $N(N\text{-}1)/2$. In the case of CEMAC we have therefore 15 inflation differentials. They are represented in Fig. 12 and the summary statistics of the convergence test are reported in Table 8.

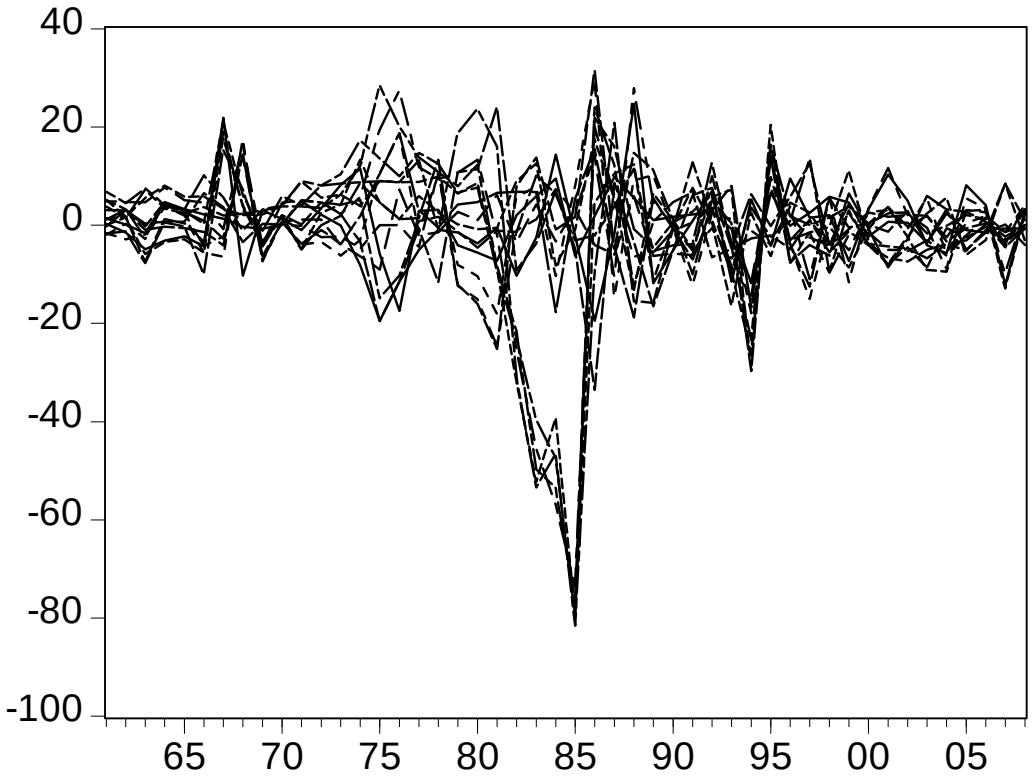

Fig. 12 – The inflation differentials among CEMAC countries

The hypothesis of non stationarity of the inflation differentials is rejected in three cases, all of them involving the Chad. Inflation dynamics in Chad appears therefore to be structurally different from that of the other CEMAC countries. Six out of 15 price differentials appears to be of "Type D" according to Busetti *et al.* (2006) classification, i.e., cases in which there is no convergence in levels, but first differences have converged. In another case (the CMR_GBN differential) inflation differentials are found to be converging. In the remaining five cases, all involving Equatorial Guinea, it appears that price level convergence is in progress.

All in all, the results are rather reassuring. Price dynamics in CEMAC, with the only exception of Chad, appears to be rather pervasive. Inflation rates are stable or are becoming stable in 7 out of 15 cases, and in another 5 cases inflation differentials are justified by the convergence of relative prices.

Table 8 – Summary results of the convergence tests on CEMAC reason

	τ_0	τ^*	ξ_0	ξ_1	A	B	C	D	E
CMR_RCA	**-7.22**	-1.34	0.22					*	
CMR_TCD	-0.87								*
CMR_CNG	**-3.30**	-1.47	0.12					*	
CMR_GBN	**-7.44**	-1.53	**0.48**				*		
CMR_GNQ	**-3.39**	**-3.37**		**0.56**	*				
RCA_TCD	-1.65								*
RCA_CNG	**-3.54**	-2.42	0.09					*	
RCA_GBN	**-2.22**	-1.32	0.16					*	
RCA_GNQ	**-2.91**	**-3.12**		**0.59**	*				
TCD_CNG	**-3.89**	-2.10	0.07					*	
TCD_GBN	-1.91								*
TCD_GNQ	**-2.34**	**-3.45**		**0.55**	*				
CNG_GBN	**-3.38**	-1.68	0.12					*	
CNG_GNQ	**-2.90**	**-3.35**		**0.51**	*				
GBN_GNQ	**-3.07**	**-3.55**		**0.58**	*				

4.4 Convergence of cycles among CEMAC countries

The most recent study on this issue is that of Carmignani (2010). Using annual GDP data from 1960 to 2007, he concludes that the degree of cycles synchronization is still very low, although slightly increasing over time. In his view, this shows that in caso of CEMAC the "endogenous OCA" theory has little empirical support, and that policy harmonization and enhancement of physical connectivity among member countries could foster the convergence process.

5. Conclusions

The literature on OCA, originated by Mundell (1961), has received a great momentum from the recent European experience, and it is obviously difficult to synthesize the content of such a huge literature. Another obvious remark is that the Eurozone and the CEMAC are two very different monetary unions, among every possible point of view (historical, political, economical, geographical), which means that Eurozone developments do not necessarily give useful indications to CEMAC policy makers.
Nevertheless, the recent crisis of the euro validates some of the argument set out in this policy study. Let us recall, in no particular order, the most important of them, and highlight their main bearings on the CEMAC case.

First and foremost, the recent crisis of the euro shows that "fiscal convergence" as considered by Maastricht treaty (and Maastricht-like treaties around the world) is an almost useless and completely misleading criterion. This should come as no surprise, because at the end of this paper we know that the OCA theory does not request fiscal *convergence*, but rather fiscal *integration*. Besides the critiques raised by Buiter (2006) on the nonsensical features of Maastricht treaty, we have shown elsewhere (Bagnai, 2010) that the emphasis put by multilateral surveillance programmes (or by international investors at

large) on the behaviour of the public sector has proven misleading in a number of recent economic crises, including the Asian crisis, the US subprimes crisis, the Iceland crisis, and the 2010 Eurozone crisis. In all these cases the financial fragility of the countries involved (1) originated in the private, rather than in the public sector, and (2) was clearly revealed by the behaviour of the current account balance, rather than by the government balance. As a consequence, monitoring the government balance gave misleading indications to the investors and the policy makers. This feature of modern financial crises was noticed first by Hussain *et al.* (1999) but has become apparent to economist in developed countries only recently. On the basis of this striking evidence, some authors like Dullien and Schwarzer (2010) propose the adoption of a "stability pact" for (intra-regional) current account imbalances.

Second, the crisis has shown that while variables unimportant in theory (like the government balance) are also unimportant in practice, at the same time variables important in theory are also important in practice: we refer, in particular, to the inflation rate, which, as recalled in the paper, is the only economic variable for which convergence is expressly requested by economic theory (since Fleming, 1971). In its dull fight against the size of the public sector (Pasinetti, 1998), Maastricht treaty very inappropriately forgets the need to monitor inflation convergence: no "excessive inflation" procedure is envisaged for "ins" by the Treaty. This has led to competitiveness shifts and disrupting external imbalances. The disastrous oversight of the inflation convergence criterion may have been motivated by theoretical arguments, such as those put forth by Giavazzi and Pagano (1988), according to which inflation convergence becomes an outcome, rather than a prerequisite, of the accession to a monetary union (which obviously implies that the "ins" do not need to monitor it). This is a central argument in the so-called "endogenous OCA" literature, that puts forth the argument that monetary union will endogenously generate the conditions for their viability (in terms of inflation convergence, of macroeconomic cycle synchronization, and so on). As far as inflation is concerned, Busetti *et al.* (2006b) results show that such an endogenous validation of the political decision to join the Eurozone did not occur in Europe. There are also some doubts that the "endogenous OCA" mechanism is at work in CEMAC (Carmignani, 2010). This stresses the need to closely monitor inflation rates.

What conclusions can be drawn for the viability of CEMAC as a monetary union on the basis of the previous discussion?

First, some structural features of CEMAC countries, such as the relatively underdeveloped financial markets and the low share of intraregional trade, while being a hindrance to growth in some respect, could also prove a blessing as far as the viability of the monetary union is concerned. The current setting of CEMAC makes it extremely unlikely that it sustainability can be endangered by private financing of huge intraregional imbalances. Of course, by this we do not mean that CEMAC countries should remain relatively insulated from each other in terms of intraregional trade, or that their financial markets should not develop. We rather would like to point out to the attention of the policy makers that these developments, while fostering growth, may also open to the possibility of regional imbalances, that have proven extremely disruptive in the case of the Eurozone.

Second, some institutional features of the CEMAC treaty prove more intelligent (or less stupid, to quote Alves and Afonso, 2007) than those of its closes forerunner (i.e., Maastricht treaty). For instance, while Maastricht treaty ignores inflation convergence for "ins", CEMAC multilateral surveillance considers the inflation rate among the "first rank" criteria. Although the reference value given (less than 3%) may be criticized as being probably too low for a set of developing countries (UNECA, 2007), the attention given to such a crucial indicator is in itself commendable (especially in the light of what has happened in Europe). Moreover, the current account balance is also monitored, although only among the "second rank" criteria. Furthermore, the "excessive deficit" procedure envisaged by the CEMAC treaty, unlike that of the SGP, does not feature automatic sanctions for the countries that do not comply with the surveillance criteria (in particular, in terms of fines, non-interest bearing deposits, and so on). While on the one hand this could be interpreted as a lack of rigour, on the other hand it is a demonstration of realism. The "pseudo-strict" rules of the SGP have never been applied for two reasons: first, because they were violated first by the strongest countries (in economic and political terms) of the Eurozone, namely Germany and France; second, because they are asymmetrical and put the burden of the adjustment on the shoulders of the weakest countries.

It should be kept in mind that OCA theory does not request that inflation be low: it requests that the member countries rate be converging. In this respect, the situation of CEMAC appears relatively reassuring, in the light of the fresh empirical evidence presented in this paper. In particular, CEMAC countries do not display persistent inflation differentials such as those that have put the Eurozone under severe strain. Drawing on the Eurozone experience, we may conclude that the most important institutional reform to be carried out, in CEMAC as in the Eurozone, would be that of define a credible and agreed upon average inflation rate toward which the member countries would be asked to converge. Convergence towards an average inflation rate (suitably defined), besides being requested by economic theory, would also solve the problems raised by the asymmetry of Maastricht like rules.

References

Alesina, A., Barro, R., Tenreyero, S. (2002) "Optimal currency areas", *NBER Working Paper*, No. 9072, July.

Alves, R.H., Afonso, O. (2007) "The 'new' Stability and Growth Pact: more flexible, less stupid?", *Intereconomics*, **42**, 218-231.

Anoruo, E., Nwafor, F. (2007) "Income convergence in developing countries", *ICFAI Journal of Applied Economics*, **6**, 69-76.

Anyanwu, J.C. (2003) "Estimating the macroeconomic effects of monetary unions: the case of trade and output", *African Development Review*, **15**, 126-145.

Artis, M. (1991) "One market, one money. An evaluation of the potential benefits and costs of forming an economic and monetary union", *Open Economies Review*, **2**, 315-321.

Bagnai, A. (1995) "Public debt sustainability and crowding-out in a dynamic keynesian model", *Giornale degli Economisti e Annali di Economia*, No. 1-3, January-March, 129-136.

Bagnai, A. (2004) "Keynesian and neoclassical fiscal sustainability indicators, with applications to EMU member countries", *Department of Public Economics Working Paper Series*, No. 75, Rome: University of Rome "La Sapienza", http://dep.eco.uniroma1.it/docs/working_papers/WP75.pdf

Bagnai, A. (2010) "CEEC vs. PIGS: a comparative panel assessment of financial sustainability and twin deficits", *Luiss Lab on European Economics Working Documents Series*, No. 89, May 2010.

Bakoup, F., Tarr, D. (2000) "The economic effects of integration in the Central African Economic and Monetary Community: some general equilibrium estimates for Cameroon", *African Development Review*, **12**, 161-190.

Baldwin, R. (2006) *In or out: does it matter? An evidence-based analysis of the euro's trade effect*, London: Centre for Economic Policy Research.

Balogun, E.D. (2008) "An empirical test of trade gravity model criteria for the West African Monetary Zone (WAMZ)", mimeo.

Barba Navaretti, G., Faini, R., Gauthier, B. (2006) "The impact of trade liberalization on enterprises in small backward economies: the case of Chad and Gabon", *Review of Development Economics*, **10**, 452-426.

Barro, R., Gordon, D. (1982) "Rules, discretion and reputation in a model of monetary policy", *Journal of Monetary Economics*, **12**, 101-121.

Barro, R., Sala-i-Martin, X. (1992) "Convergence", *Journal of Political Economy*, **100**, 223-251.

Bayoumi, T., Eichengreen, B. (1992) "Shocking aspects of European Monetary Unification", in Giavazzi, F., Torres, R. (eds.) *The transition to Economic and Monetary Union in Europe*, Cambridge: CUP.

Bayoumi, T., Goldstein, M., Woglom, G. (1995) "Do credit markets discipline sovereign borrowers? Evidence from the US States", *Journal of Money, Credit and Banking*, **27**, 1046-1059.

Benassy-Quere, A., Coupet, M. (2005) "On the adequacy of monetary arrangements in Sub-Saharan Africa", *World Economy*, **28**, 349-373.

Ben Hammouda, H., Karingi, S.N., Njuguna, A.E., Jallab, M.S. (2007) "Does macroeconomic convergence lead to growth? The case of Africa", paper presented at the African Economic Conference "Opportunities and challenges of

development for Africa in the global arena", Addis Ababa, 16-17 November 2007.
Bernard, A.B., Durlauf, S.N. (1995) "Convergence in international output", *Journal of Applied Econometrics*, **10**, 97-108.
Blanchard, O., Dell'Ariccia, F., Mauro, P. (2010) "Rethinking economic policy", *IMF Staff Position Note*, No. 3.
Blanchard, O., Quah, D. (1989) "The dynamic effect of aggregate demand and aggregate supply disturbances", *American Economic Review*, **79**, 655-573.
Broz, T. (2005) "The theory of optimum currency areas: a literature review", *Privredna kretanja i ekonomska politika*, **104**, 53-78.
Buiter, W.H. (2006) "The 'Sense and Nonsense of Maastricht' revisited: what have we learnt about stabilization in EMU?", mimeo.
Buiter, W.H., Corsetti, G., Roubini, N. (1993) "Excessive deficits: sense and nonsense in the Treaty of Maastricht", *Economic Policy*.
Busetti, F., Fabiani, S., Harvey, A. (2006) "Convergence of prices and rates of inflation", *Oxford Bulletin of Economics and Statistics*, **68**, 863-877.
Busetti, F., Forni, L., Harvey, A. and F. Venditti (2006b) "Inflation convergence and divergence within the European Monetary Union" *European Central Bank Working Paper Series*, No. 574, January.
Calvo, G., Reinhart, C.M. (2000) "Fear of floating", *NBER Working Paper*, No. 7993.
Canzoneri, M.B., Diba, B. (1996) "Fiscal constraints on central bank independence and price stability", *CEPR Discussion Papers*, No. 1463.
Canzoneri, M.B., Diba, B. (1999) "The stability and growth pact: a delicate balance or an albatross?", *Empirica*, **26**, 241-258.
Carmignani, F. (2010) "Endogenous Optimal Currency Areas: the case of the Central African Economic and Monetary Community", *Journal of African Economies*, **19**, 25-51.
Chalk, N., Hemming, R. (2000) "Assessing sustainability in theory and practice", *IMF Working Paper*, No. 81.
Coulibaly, B. (2009) "Currency unions and currency crises: an empirical assessment", *International Journal of Finance and Economics*, 14, 199-221.
De Grauwe, P. (1992) *The Economics of Monetary Integration*, Oxford: OUP.
De Grauwe, P. (1996) "Monetary union and convergence economics", *European Economic Review*, **40**, 1091-1101.
De Grauwe, P., Vanhaverbeke, W. (1991) "Is Europe an Optimum Currency Area? Evidence from regional data", *CEPR Discussion Papers*, No. 555.
Dornbusch, R., Fischer, S., Startz, R. (2004) *Macroeconomics*, New York: McGraw Hill/Irwin.
Douven, R., Peeters, M. (1998) "GDP-spillovers in multi-country models", *Economic Modelling*, **15**, 163-195.
Dullien, S., Schwarzer, D. (2010) "The EMU needs a stability pact for intra-regional current account imbalances", in Botsch, A., Watt. A. (eds.) *After the crisis: towards a sustainable growth model*, Brussels: ETUI.
Eichengreen, B. (2007) "The breakup of the Euro area", *NBER Working Papers*, No. 13393, Cambridge (Mass.), National Bureau of Economic Research.
Elbadawi, I., Majd, N. (1996) "Adjustment and economic performance under a fixed exchange rate: a comparative analysis of the CFA zone", *World Development*, **24**, 939-951.

Engle, R.F. and C.W.J. Granger (1987) "Cointegration and error correction: representation, estimation and testing", *Econometrica*, **55**, 251-276.
Faini, R. (2006) "Fiscal policy and interest rates in Europe", *Economic Policy*, **47**, 445-489.
Feldstein, M. (2005) "The euro and the stability pact", *Journal of Policy Modeling*, **27**, 421-426.
Ferré, M. (2008) "Fiscal policy coordination in the EMU", *Journal of Policy Modeling*, **30**, 221-253.
Fielding, D., Shields, K. (2001) "Modelling macroeconomic shocks in the CFA Franc Zone", *Journal of Development Economics*, **66**, 199-233.
Fielding, D., Shields, K. (2005) "Do currency unions deliver more economic integration than fixed exchange rates? Evidence from the Franc Zone and the ECCU", *Journal of Development Studies*, **41**, 1051-1070.
Fischer, S. (1987) "International macroeconomic policy coordination", *NBER Working Paper*, No. 2244, May.
Fleming, J.M. (1971) "On exchange rate unification", *Economic Journal*, **81**, 467-488.
Fouda, S.M., Stasavage, D. (2000) "The CFA franc zone after EMU: status quo, reform or dissolution?", *The World Economy*, **23**, 221-233.
Frankel, J.A. (1999) "No single currency regime is right for all countries or at all times", *Essays in International Finance*, No. 215, Princeton University.
Frankel, J.A., Rose, A.K. (1997) "Is EMU more justifiable ex post than ex ante?", *European Economic Review*, **41**, 753-760.
Friedman, M. (1953) "The case of flexible exchange rates", in Friedman, M. (ed.) *Essays in Positive Economics*, Chicago: University of Chicago Press, 157-203.
Friedman, M. (1968) "The role of monetary policy", *American Economic Review*, **58**, 1-17.
Fuchi, H., Oda, N., Ugai, H. (2008) "Optimal inflation for Japan's economy", *Journal of Japanese and International Economics*, **22**, 439-475.
Fuhrer, J.G. (1995) "The Phillips curve is alive and well", *New England Economic Review*, March-April, 41-57.
Gandolfo, G. (2002) *International Finance and Open-Economy Macroeconomics*, Berlin: Springer Verlag.
Giavazzi, F., Pagano, M. (1988) "The advantage of tying one's hand: EMS discipline and central bank credibility", *European Economic Review*, **32**, 1055-1082.
Hadjimichael, T., Galy, M. (1997) "The CFA franc zone and the EMU", *IMF Working Paper*, No. 156, Washington: International Monetary Fund.
Hafer, R.W., Kutan, M. (1994) "A long-run view of German dominance and the degree of policy convergence in the EMS", *Economic Inquiry*, **32**, 684-695.
Hall, S.G., Robertson, D., Wickens, M.R. (1997) "Measuring economic convergence", *International Journal of Financial Economics*, **2**, 131-143.
Hamilton, J.D., Flavin, M.D. (1986) "On the limitations of government borrowing: a framework for empirical testing", *American Economic Review*, **76**, 808-819.
Harvey, A., (1990) *The econometric analysis of time series*, Deddington: Phillip Allan (2nd edition).
Hau, H. (2006) "Interest-rate spillovers: a desirable 'internality'", *Economic Policy*, **47**, 481-484.
Hughes Hallett, A.J. (2000) "Aggregate Phillips curves are not always vertical: heterogeneity and mismatch in multiregion or multisector economies", *Macroeconomic Dynamics*, **4**, 534-546.

Hussain, M.N. (1999) "The balance-of-payment constraints and growth rate differences among African and East Asian economies", *African Development Review*, **11**, 103-137.
Hussain, N.M., Mlambo, K. and T. Oshikoya (1999) "Global financial crisis: an African perspective", *African Development Review* **11**, 199-232.
Iacobucci, A. (2003) "Spectral analysis for economic time series", *Documents de travail de l'OFCE*, No. 7, Paris : OFCE.
Iossifov, P., Kinoshita, N., Takebe, M., York, R., Zhan, Z. (2009) "Improving surveillance across the CEMAC region", *IMF Working Paper*, 260, Washington: IMF.
Islam, N. (2003) "What have we learned from the convergence debate?", *Journal of Economic Surveys*, **17**, 309-362.
Johansen, S. (1988) "Statistical analysis of cointegration vectors", *Journal of Economic Dynamics and Control*, **12**, 231-254.
Jouini, J. (2009) "Analysis of structural break models based on the evolutionary spectrum: Monte Carlo study and application", *Journal of Applied Statistics*, **36**, 91-110.
Kaufmann, D., Kraay, A., Mastruzzi, M. (2008) „Governance Matters VII: Governance Indicators for 1996-2007", *World Bank Policy Research*, June.
Kenen, P.B. (1969) "The theory of Optimum Currency Areas: an eclectic view", in Mundell, R.A., Swoboda, A.K. (eds.) *Monetary Problems of the International Economy*, Chicago: University of Chicago Press, 41-60.
Khan, M., Senhadji, A. (2000) "Threshold effects in the relationship between inflation and growth", *IMF Working Paper*, **110**, Washington: IMF.
Kirman, A.P. (1992) "Whom or what does the representative individual represent?", *Journal of Economic Perspectives*, **6**, 117-136.
Kwiatowski, D., Phillips, P.C.B., Schmidt, P., Shin, Y. (1992) "Testing the null hypothesis of stationarity against the alternative of a unit root: how sure are we that economics time series have a unit root?", *Journal of Econometrics*, **44**, 159-178.
Lippi, M. (1988) "On the dynamic shape of aggregated error correction models", *Journal of Economic Dynamics and Control*, **12**, 561-585.
Loufir, R., Reichlin, L. (1993) "Convergences nominale et réelle parmi les pays de la CE et de l'AELE", *Revue de l'OFCE*, **43**, 69-92.
Lovell, M.C. (1986) "Tests of the rational expectations hypothesis", *American Economic Review*, **76**, 110-124.
Lucas, R.E., Rapping, L.A. (1969) "Price expectations and the Phillips curve", *American Economc Review*, **59**, 342-350.
MacDonald, R., Taylor, M.P. (1991) "Exchange rates, policy convergence, and the European Monetary System", *Review of Economics and Statistics*, **73**, 553-558.
Mankiw, N.G., Taylor, M.P. (2008) *Macroeconomics – European edition*, New York, Basingstoke: Worth Publishers.
Masson, P., Pattillo, C. (2001) "Monetary union in West Africa: an agency of restraint for fiscal policies?", *IMF Working Papers*, No. 34.
Masson, P., Pattillo, C. (2004) "A single currency for Africa?", *Finance and Development*, December, 9-15.
Mata, J.-E. (2008) "Effet de la CEMAC sur l'intégration sou-régionale : cas du Cameroun, du Congo et du Gabon", *African Integration Review*, **2**, 1-32.
McKinnon, R.J. (1963) "Optimum currency areas", *American Economic Review*, **53**, 717-725.

Melitz, J. (1991) "Brussels on a single money", *Open Economies Review*, **2**, 323-336.
Mintz, N. (1970) *Monetary Union and Economic Integration*, New York University Press.
Mundell, R. (1961) "Theory of optimum currency areas", *American Economic Review*, **51**, 657-665.
Mundell, R. (1973) "A plan for a European currency", in H.G. Johnson and A.K. Swoboda (eds), *The Economics of Common Currencies*, London: Allen&Unwin, 143-172.
Mundell R. (1973b), "Uncommon Arguments for Common Currencies", in Johnson, H.G., Swoboda, A.K. (eds.), *The Economics of Common Currencies*, London: George Allen and Unwin, pp. 114-32.
Mundell, R. (2005) "The case for a world currency", *Journal of Policy Modeling*, **27**, 465-475.
Mundell, R. (2009) "The world economy: quo vadis?", *Journal of Policy Modeling*, **31**, 493-497.
Ndiaye, M.B.O. (2007) "Respect des critères de convergence vs harmonisation des critères de convergence: étude comparative des performances des indicateurs de convergence économique dans la zone Franc en Afrique (UEMOA et CEMAC) », *Revue Africaine de l'Integration*, **1**, 1-42.
Nitsch, V. (2002) "Honey I shrunk the currency union effect on trade", *World Economy*, **25**, 457-474.
Obinyeluaku, M., Viegi, N. (2009) "Can monetary union alone provide an agency of restraint for Africa?", paper presented at the 14th Annual Conference on Econometric Modelling in Africa, Abuja, July 8-10, 2009.
Ojo, M. (2002) "Regional currency areas and use of foreign currencies: the experiences of West Africa", *BIS Papers*, **17**, 140-144.
Pasinetti, L.(1998) "The myth (or folly) of the 3% defict/GDP Maastricht 'parameter'", *Cambridge Journal of Economics*, **22**, 103-116.
Persson, T. (2001) "Currency unions and trade: how large is the treatment effect?", *Economic Policy*, **33**, 435-448.
Pisani-Ferry, A. (2004) "Reforming the SGP: does it matter? What should be done?", in Liddle, R., Rodrigues, M.J. (eds.) *Economic reform in Europe – Priorities for the next five years*", Policy Network.
Rose, A.K. (2000) "One money, one market: the effect of common currencies on trade", *Economic Policy*, **30**, 9-45.
Rose, A.K. (2001) "Currency unions and trade: the effect is large", *Economic Policy*, **33**, 449-461.
Strauss-Kahn (2002) "Regional currency areas: a few lessons from the experiences of the Eurosystem and the CFA franc zone", *BIS Papers*, **17**, 43-58.
Sumner, M. (1986) "Are economist rational?", *Applied Economics*, **15**, 453-456.
Tavlas, G.S. (1993) "The 'new' theory of optimum currency areas", *World Economy*, **13**, 663-685.
Thirlwall, A.P. (2000) "Trade, trade liberalisation and economic growth: theory and evidence", *Economic Research Papers*, No. 63, Abidjan: African Development Bank.
Tornell, A., Velasco, A. (2000) "Fixed versus flexible exchange rates: which provides more fiscal discipline?", *Journal of Monetary Economics*, **45**, 399-436.
Tsangarides, C., Ewenczyk, P., Hulej, M. (2006) "Stylized facts on bilateral trade and currency unions: implications for Africa", *IMF Working Papers*, No. 31.
Tsangarides, C., Ewenczyk, P., Hulej, M., Qureshi, M.S. (2009) "Are Africa's currency unions good for trade?", *IMF Staff Papers*, **56**, 876-918.
UNECA (2007) *Convergence économique en Afrique Centrale*, Yaoundé : CEA/BSR-AC.

UNECA (2008) *Prospectus sur l'état de l'intégration en Afrique centrale*, Yaoundé : CEA/BSR-AC.

UNECA (2009) *Etat d'avancement du processus d'intégration en Afrique centrale – Rapport 2010*.

Warin, T., Wunnava, P.V., Janicki, H. (2009) "Testing Mundell's intuition of endogenous OCA theory", *Review of International Economics*, **17**, 74-86.

Zee, H.H. (1988), "The sustainability and optimality of government debt", *IMF Staff Papers*, **35**, 658-685.

Appendix

1.1 Public debt dynamics

Let D_t be the stock of nominal public debt at the end of year t, and F_t be the nominal public deficit:

$$F_t = \Delta D_t \tag{1}$$

We indicates with small letters the ratios of the variables to nominal GDP. Therefore:

$$\frac{\Delta D_t}{Y_t} = f_t \tag{2}$$

where $f_t = F_t/Y_t$. Let γ_t be the rate of growth of nominal GDP. The deficit-to-GDP ratio can be decomposed as follows:

$$\frac{\Delta D_t}{Y_t} = \frac{D_t - D_{t-1}}{Y_t} = \frac{D_t}{Y_t} - \frac{D_{t-1}}{(1+\gamma_t)Y_{t-1}} = d_t - \frac{1}{1+\gamma_t} d_{t-1} \tag{3}$$

By substituting Eq. (3) in Eq. (2) we obtain the dynamic equation of the debt-to-GDP ratio:

$$d_t = \frac{1}{1+\gamma_t} d_{t-1} + f_t \tag{4}$$

Assuming a constant path for both the nominal growth rate and the deficit-to-GDP ratio we get:

$$d_t = \frac{1}{1+\gamma} d_{t-1} + f \tag{5}$$

As a consequence, the steady state value of the debt-to-GDP ratio is:

$$\bar{d} = \frac{(1+\gamma)f}{\gamma} \tag{6}$$

For small values of the nominal growth rates the steady state value can be approximated by $\bar{d} \approx f/\gamma$ (ratio of the deficit-to-GDP ratio to the nominal growth rate).

1.2The intertemporal budget constraint

Since Hamilton and Flavin (1986) the analysis of public debt sustainability is grounded on the *government intertemporal budget constraint* (or *solvency constraint*, or *present value borrowing constraint*). In order to define the solvency constraint, let us express the government budget identity in discrete time as a ratio to GDP as follows

$$\frac{B_t}{y_t} = \frac{1+r}{1+n} \frac{B_{t-1}}{y_{t-1}} - a_t \tag{7}$$

where B_t is the real stock of bond issued by the government evaluated at the end of time t, y_t is real GDP, r is the real interest rate on public debt prevailing between t-1 and t, n is the real rate of growth, and a_t is the primary surplus/GDP ratio (including seigniorage). We assume constant interest and growth rates in order to keep the notation as simple as possible. By leading identity (7), solving it with respect to the current value of B_t/y_t, and iterating it forward we obtain

$$\frac{B_t}{y_t} = \sum_{j=1}^{\infty}\left(\frac{1+n}{1+r}\right)^j E_t\left[a_{t+j}\right] + \lim_{j\to+\infty}\left\{\left(\frac{1+n}{1+r}\right)^j E_t\left[\frac{B_{t+j}}{y_{t+j}}\right]\right\} \tag{8}$$

Remark that since the debt/GDP ratio can in principle take any value in the limit, equation (8) does not constrain the current value of B_t/y_t for any given path of a_t.
The *solvency constraint* is set by imposing that

$$\lim_{j\to+\infty}\left\{\left(\frac{1+n}{1+r}\right)^j E_t\left[\frac{B_{t+j}}{y_{t+j}}\right]\right\} = 0 \tag{9}$$

The constraint (9) implies that:

$$\frac{B_t}{y_t} = \sum_{j=1}^{\infty}\left(\frac{1+n}{1+r}\right)^j E_t\left[a_{t+j}\right] \tag{10}$$

i.e., that the current value of the debt is equal to the expected present value of the infinite stream of future surpluses, which means that when the constraint is in force the debt must eventually be repaid, i.e., that the government must realize in the future at least one primary surplus (if the current value of the debt stock is positive, there must be at least one positive value of a_t in the summation for the constraint to hold). Remark that in a growing economy, for the constraint (9) (or (10)) to be verified it suffices that B_t/y_t does not grow at a rate exceeding $(1+r)/(1+n) - 1 \approx r - n$; this happens when the service of the debt is not covered entirely by issuing new debt.

1.3 Definitions of convergence based on time series analysis

Convergence in expectation and cointegration

Hall *et al.* (1997) consider two stochastic series X_t and Y_t, possibly contaminated by measurement errors. Their preferred definitions of convergence are convergence *in expectation*:

$$\lim_{t\to\infty} E\left(X_t - \theta Y_t\right) = \alpha$$

and convergence *in conditional expectation*:

$$\lim_{k\to\infty} E\left(X_{t+k} - \theta Y_{t+k} \middle| I_t\right) = \alpha$$

where θ and α are known constants and I_t is the information set at time *t*. Hall *et al.* (1997) go on to remark that if the two series are both stationary convergence in expectation is trivially satisfied,[52] which means that the study of convergence is relevant only for non stationary variables (this assertion is questionable, as we shall see later).
If X_t and Y_t are non-stationary variables of the $I(1)$ type, convergence in expectations obtains when they are cointegrated with cointegrating vector $(1, -\theta)$. Most of the subsequent literature rests on this definition, thereby identifying convergence with cointegration. However, Hall *et al.* (1997) are very careful in stressing that cointegration is both too strong and too weak for a sensible convergence definition. It is too strong, because convergence is determined by the limiting behaviour of the series, while

[52] If X_t and Y_t are weak-sense stationary, they have constant means (say μ_X and μ_Y respectively), therefore convergence in expectations is trivially satisfied with $\mu_X - \mu_Y = \alpha$.

cointegration is a property of the whole time history of the series; broadly speaking, in order to be cointegrated two series need to move together along the whole sample, while in order to be converging they just need to move closer together towards the end of the sample, which is perfectly compatible with *non* cointegration: hence, *non cointegration does not imply non convergence*. Cointegration may also be too weak a criterion, as convergence could require further parameter restrictions, depending on the economic meaning and on the units of measurement of the variables: hence, *cointegration does not imply convergence*. For instance, Hall *et al.* (1997) put it, if the variables are in logs, "sensible convergence would imply that $\theta=1$" (more on this later). In this respect, Bernard and Durlauf (1995),[53] distinguish between "convergence", that occurs when

$$\lim_{t\to\infty} E(X_t - Y_t) = 0$$

and "common trends", that occur when

$$\lim_{t\to\infty} E(X_t - \theta Y_t) = 0$$

Therefore, in Bernard and Durlauf language, convergence corresponds to cointegration with the additional constraint $\theta = 1$.

Convergence in variable parameters models

In order to define an operational criterion for convergence that does not restrain the whole history of the observed variables, variable parameters model are needed.

For instance, Loufir and Reichlin (1993) estimate the following model:

$$X_{At} - X_{It} = \alpha_t + \beta_t (X_{At} - X_{Bt}) + u_t$$

where X_{It} is the value of indicator X at time t in country I, and X_{At} and X_{Bt} are the values of the same indicators in two reference countries A and B. In this variable parameters setting, we can say that I is converging towards A whenever $\lim_{t\to\infty} E(\beta_t) = 0$ and $\lim_{t\to\infty} E(\alpha_t) = 0$, while I is converging towards B whenever $\lim_{t\to\infty} E(\beta_t) = 1$ and $\lim_{t\to\infty} E(\alpha_t) = 0$.

The equation can be estimated through the Kalman filter or recursive least squares (if the variables are stationary), and the time pattern of the parameters provide hints on the convergence of variables.

In the variable parameters model proposed by Hall *et al.* (1997):

$$X_t - \theta Y_t = \alpha_t + \varepsilon_t$$

$$\alpha_t = \alpha_{t-1} + u_t$$

$$\varepsilon_t \sim N(0, \sigma^2)$$

$$u_t \sim N(0, \omega_t)$$

$$\omega_t = \varphi \omega_{t-1}$$

convergence in means occurs whenever $\varphi<1$, which implies that ω_t converges to zero, α_t converges to a deterministic constant, and $\lim_{t\to\infty} E(X_t - \theta Y_t) = \alpha$. Convergence in this case has a testable implication ($\varphi<1$). Appropriate maximum likelihood tests may be constructed using the Kalman filter.

Stability and convergence among stationary variables

[53] Bernard and Durlauf (1995) use actually the conditional expectations definition of convergence. We skip this technical difficulty as it does not alter the meaning of our analysis.

Hall's *at al.* (1997) remark that convergence in expectations is "trivially satisfied" in case of stationary variables is clearly unsatisfactory. There are a number of economic problems in which convergence among two stationary variables matters: the best example comes probably from OCA theory, where it is crucial to assess whether the inflation rates (not the prices!) of the member countries have converged.[54] While it is true that the expectation of the (scaled) difference between two second-order stationary variables will always be a constant α, it is at the same time true that for this to provide a sensible definition of convergence some parameter restraints are needed. Let for instance X_t be the inflation rate of Cameroon and Y_t that of Gabon, supposed to be stationary variables.[55] In this case a sensible definition of convergence would imply that $\theta=1$ *and* $\alpha=0$, i.e., that the expectations of the two rate do not differ systematically in the limit. This condition is not "trivially satisfied": should this be the case, convergence in expectations would be useless for our purposes. A closer look at the logical structure of the problem however shows that the uselessness of Hall's *at al.* definition comes from their bias towards non stationary series, possibly motivated by the need to utilize the framework of the then recent and fashionable cointegration analysis, which deals essentially with non stationary series.[56] However, rather than look for problems and data that make sense for a given instrument, an economist should be able to find instruments that make sense for a given problem. This is what does Andrew Harvey with his co-authors in a paper that considers explicitly the issue of convergence for both prices and the rates of inflation (Busetti *et al.*, 2006).

Let Z_t be the difference between two non-stationary time series. If this difference is stationary, the series will be said to have a *stable* relationship. This can be assessed using a *stationarity* test of the KPSS type (from Kwiatowski *et al.*, 1992) on the demeaned observations $E_t = Z_t - \overline{Z}$. If however the Z_t are known or assumed to have a zero mean under the null, the test can be carried out on the original Z_t series. Remark that in this case the rejection may imply that *either* the spread is non stationary, *or* that it has a non zero mean.

The two series instead are said to *converge* if

$$\lim_{k\to\infty} E\left(Z_{t+k}|I_t\right)=\alpha$$

where I_t contains all the past history of Z_t. The convergence is said to be *absolute* if $\alpha=0$ and *relative* (or conditional) if $\alpha\neq0$. Absolute convergence then coincides with Bernard and Durlauf (1995) convergence. Busetti *et al.* (2006) go on to show that the simplest parameterization of convergence is provided by an AR(1) process of this kind

$$Z_t - \alpha = \varphi(Z_{t-1} - \alpha) + \eta_t$$

that can be reparameterized as follows:

$$\Delta Z_t = \gamma + (\varphi-1)\, Z_{t-1} + \eta_t$$

If $\varphi<1$, then the expected growth rate of Z_t is a negative fraction $(\varphi-1)$ of the spread between the two variables in the previous period, Z_{t-1}, and in this case Z_t converges to α. If instead $\varphi=1$, the spread is not corrected in each period, and the two variables do not converge. Convergence can therefore be tested using a unit root test. If we are testing for

[54] This is not the only sloppy feature of Hall's *et al.* paper. Another surprising feature is that the definition of conditional convergence they give is wrong (check Bernard and Durlauf, 1995 for a comparison).

[55] This is not a trivial assumption, as most nominal variables are found to be *I*(2), which means that inflation rates could actually be *I*(1).

[56] For this reason, some previous studies on convergence in the CEMAC have considered price rather than inflation convergence (e.g., UNECA, 2007). As we shall see later, this determines some inconsistencies.

absolute convergence, or if we know that $\alpha=0$, we can use the usual ADF statistic with no intercept. If instead we test for relative convergence, we can use a modified DF test carried out on the observations $Z_t - Z_T$: in other words, we set the unknown α equal to the last value of the observed series. These critical values of the modified DF statistics are provided by Busetti *et al.* (2006).

How does this framework adapt to the issue of testing price behaviour? In this case convergence in levels corresponds to the study of relative prices, whereas convergence in first differences deals with inflation differentials. An important point is that in studying price indices it is impossible to discriminate between absolute and relative convergence. The reason is that two price indices can always be rebased in such a way as to coincide at the end of the sample (i.e., $Z_T=0$ can always be obtained by construction). This does not apply to inflation rates (as the base years cancel out through differencing): therefore, it makes sense test for absolute convergence of inflation rates.

Busetti *et al.* (2006) then propose a three-step testing strategy:

1) test for absolute convergence of the inflation rates using a unit root test on inflation differentials:
   a. if we accept the null of no inflation convergence, the procedure ends, because if inflation rates do not converge, neither will price levels;
   b. if we reject the null, we move to step 2 in order to verify whether the convergence of inflation differentials implies also the convergence of the price levels.
2) test for relative convergence of price levels using a modified DF test:
   a. reject the null of no convergence in level: in this case, a stationarity test is needed in order to verify whether the level of the series have already converged or are still converging;
   b. accept the null of non convergence in level: in this case, since we did not reject in step 1 the hypothesis of inflation convergence, a stationarity test is needed for the inflation rates in order to assess whether they have converged or are still converging.
3) stationarity tests:
   a. on price levels (under 2.a):
      i. accept: price levels have converged, i.e., there will be no further adjustment of relative prices;
      ii. reject: price levels are converging, i.e., there will be some further adjustment of relative prices;
   b. on inflation differentials (under 2.b):
      i. accept: inflation rates have converged (this is the restrictions relevant for OCA theory);
      ii. reject: inflation rates are converging (this would be a hint of an "endogenous OCA" process).

The procedure therefore leads to five possible different outcomes: (1) the convergence in level is achieved; (2) the convergence in level is in progress; (3) the convergence in inflation rates is achieved (which is compatible with a persistent spread in the level series); (4) the convergence in inflation rates is in progress; (5) there is no convergence in inflation rates (hence, in price levels). Another interesting feature of these tests is that they can be carried out pairwise, and the results are informative on the possible existence and structure of "price (or inflation) convergence clubs" in a given region.