Economic Issues, Vol. 15, Part 2, 2010

Monetary Variability and Monetary Variables in the Franc Zone

Simeon Coleman and Michail Karoglou[1]

ABSTRACT

Failure to detect or account for structural changes in economic modelling can lead to misleading policy inferences, which can be perilous, especially for the more fragile economies of developing countries. Using three potential monetary policy instruments (Money Base, M0, and Reserve Money) for 13 member-states of the CFA Franc zone over the period 1989:11-2002:09, we investigate the magnitude of information extracted by employing data-driven techniques when analyzing breaks in time-series, rather than the simplifying practice of imposing policy implementation dates as break dates. The paper also tests Granger's (1980) aggregation theory and highlights some policy implications of the results.

1. INTRODUCTION

THE IMPORTANCE OF MONETARY VARIABLES in macroeconomic modelling is readily evident in almost all applied macroeconomic literature. Capturing the idiosyncratic behaviour of their time-series dynamics is essential, particularly when one considers the impact of monetary variability on inflation uncertainty and decreasing levels of economic activity.[2] Although the sources of monetary variability can be quite diverse — ranging from differing national monetary policies or money demand disturbances to speculative short-term international capital transactions — the association between high monetary variability, inflation uncertainty and decreasing levels of economic activity should be an important policy issue.[3]

On the one hand, substantial empirical evidence suggests a welfare-reducing property of monetary variability (see for example the rational expectations macro-models of Barro, 1976; Gray,1976). On the other hand, Devereux (1987) finds evidence to the contrary. This apparent contradiction of views notwithstanding, the accepted view is that high monetary variabilityis associated with substantial policy implications.[4] It is plausible to infer that the overall effect, whetherpositive or negative, islikely tobe morepronounced in small and developing economies, not least, because of less developed financial markets and the central role of holding physical cash. Fielding (2004, p.2), in an article on the Franc zone of sub-Saharan Africa, states that 'Manipulating M0 is still a potentially effective monetary policy strategy in countries where where financial marketsareunderdeveloped and cash makes up a large fraction of the money stock'.[5] However, as M0 is the poor person's financial asset, it is most likely that the poor will bear the brunt of any inflationary spikes. Consequently, the issue of monetary variability, although important to any economy, is paramount to welfare and policy formulation in developing and transitional economies.

The recent empirical literature has addressed the issue of monetary variability by considering breaks in corresponding series. In almost all cases, the breaks are identified using exogenous information such as the announcement or the implementation date of a particular monetary policy. Such methodologies are relatively simple to implement, but imply not only that the impact of monetary policy on monetary variability is instantaneous and easily identified, but also that a significant change in monetary policy generates at most a single break in monetary variability. A more realistic methodology would consider possible transitional periods between an announcement date, implementation date(s) and the actual date(s) that monetary variability changes are observed. In addition, it would test for the existence of any other breaks that might exist in the series. However, the inherent complexity of implementing such methods would be unnecessary if their results turned out to be similar to the results of the simpler and less rigorous methodologies.

Along these lines, the first purpose of this paper is to introduce a framework for conducting time-series analysis of monetary variability which makes use of recent advances in the non-parametric methods of detecting breaks in the mean and volatility dynamics. More data becoming readily available guarantees that such methods will continue becoming more popular in empirical work. In addition, because the underlying methods are data-driven, their results depend primarily on the properties of the available data and not on a collection of exogenous information.[6]

The second purpose of the paper is to investigate, empirically, whether results obtained from a methodology drawn from this framework are different from results obtained from the standard methodology of imposing the break-date using exogenous information. Using data from the *Communauté Financière Africaine* (hereafter CFA) Franc Zone of sub-Saharan Africa, we find that in many cases not only do the results differ, but the evolution of monetary variability is substantially richer than thought *a priori*. In fact, we show that the use of the standard methodology appears to average out the effects of monetary variability. Consequently, moving beyond the standard paradigm is not only an

academic exercise, but is a crucial challenge for policy formulation.
Finally, the third purpose of the paper is to examine the extent to which the use of different monetary variables can affect inferences based on the evolution of monetary variability. Using three monetary variables, the Money Base (aggregate variable), M0 and Reserve Money (as the disaggregated variables), we and thatinmostcasesinference about monetary variability can be substantially affected by the choice of instrument used to measure it.[7] Interestingly, when viewed in terms of Granger's (1980) aggregation hypothesis, the results suggest that the disaggregated data contain much more information than the aggregated data. This finding, in the context of monetary variability, is as interesting as it is unsettling for those who construct the macro-models which inform policy makers' decisions given the weight it places on the appropriate choice of target instrument.

The rest of the paper is organised as follows. Section 2 provides a brief overview of monetary variability and relates this to the relevance of a currency devaluation incident as considered for the Franc zone. Section 3 describes the proposed procedure for modelling monetary variability. Section 4 describes the data employed and discusses theempirical results. Section5 lays out some possible policy implications of the findings and Section 6 concludes.

2. Monetary Variability and Currency Devaluation in the Franc Zone

One of the most acknowledged monetary policy issues, which is also directly relevant to monetary variability, is the issue of currency devaluation. As a policy issue, it relays key signals about the economy to internal and external observers. Consequently, the corresponding behaviour of monetary variables, that are likely to be targeted by monetary authorities in the event of currency devaluation, should attract a lot of attention from both policy makers and the research community. Indeed, since the 1970's research in this area has grown steadily, but is still relatively limited.[8] For our purposes, this offers a solid platform on which we can base our analysis. The traditional paradigm suggests that the currency devaluation (implementation) date introduces, at most, a single (and known) break. We focus on the CFA Franc zone African economies and for very good reasons. First, these countries are all classified as developing economies. Second, they share a common currency, and the January 1994 currency devaluation date is well known and uncontested. This uniformity will prove invaluable for drawing general conclusions.[9]

3. Methodology

The statistical procedure used in this paper shows a method for capturing the dynamics of monetary variability. It centers around a 'Nominating-Awarding' procedure (see Karoglou, 2006a), which can be used to provide robust estimates of volatility around policy implementation dates. On the one hand, the traditional paradigm suggests quite simply that the only breakdate is the official policy implementation/announcement date. On the other hand, the *Nominating-Awarding* procedure suggests the use of a method of detecting all the potential breakdates in the series, and then a further method for determining which of these dates are, indeed, breakdates. In both stages, once breakdates have been identified the sample can be split accordingly into contiguous segments. Then an estimator of the standard deviation can provide a measure of the variability in each segment.[10]

In this paper, apart from the sample standard deviation, we also use the square-root of a *Heteroscedasticity and Autocorrelation Consistent* (HAC) estimator of the variance. Consequently, we have not only a second more robust estimate of monetary variability, but also a rather straightforward method of assessing the impact of heteroscedasticity and autocorrelation on the simple measures of monetary variability. Specifically, we use the VARHAC estimator of den Haan and Levin (1997), which bypasses the issue of selecting for estimation an appropriate bandwidth.[11]

The above methodology is applied to three principal monetary variabless: the Money Base and its components — M0 and Reserve Money. In this way we have also a direct way of testing Granger's (1980) aggregation hypothesis; in other words we determine whether the disaggregated data contain more information than the aggregate data. If the number and/or timing of the breaks identified in M0 and Reserve Money do not correspond to the breaks in the Money Base then the disaggregated data contains more information about monetary variability than the aggregated data and, therefore, should be preferred for macro-modelling. This is particularly important for policy making, when decisions are based on inferences that are sensitive to the underlying econometric model. It is instructive at this stage to outline the *Nominating-Awarding* procedure.

The Nominating breakdates stage

The *Nominating breakdates* stage detects all the dates that could potentially be breakdates.[12] A possible method is to use exogenous information, which is exactly what the traditional paradigm on monetary variability suggests (1994:01, in our case). To avoid imposing such a restriction on the information the data can provide, using a data-driven method is suggested. This paper makes use of several statistical procedures, based on a number of recently developed non-parametric tests that detect a single break in volatility dynamics. Specifically, we use: (i) the test of Inclan and Tiao, 1994 (I&T); (ii) the two tests of Sansó, Aragó, and Carrion, 2003 (SAC1 and, depending on whether we use the *Bartlett* or *V ARHAC* kernel variant, SAC_2^{BT} and SAC_2^{VH}); (iii) the modified version of the test of Kokoska and Leipus, 2000 (K&L) as proposed by Andreou and Ghysels, 2002 (again, depending on whether we use the *Bartlett* or *V ARHAC* kernel variant, $K\&L_{BT}$ and $K\&L_{VH}$); and (iv) the test of Lee, Tokutsu and Maekawa, 2003 (*LTM*).

A key property of these tests is that they do not distinguish between breaks in the mean and volatility dynamics (Karoglou,2006b). For our purposes, this is a plausible characteristic, since both types of break have to be taken into account. Some other properties of these tests worth mentioning include the following: *I&T* has been found to be most sensitive to the existence of volatility breaks for independent and identically distributed (iid) data, but suffers severe size distortions for strongly dependent data. In contrast, the variants of the *K&L* and SAC_2 tests do not exhibit size distortions for strongly dependent data, but are known to exhibit lower power. The performance of both the SAC_1 and *LTM* tests lie somewhere in between. In general, the relative performance of each of the above tests depends on the underlying data-generating process (DGP).[13] Therefore, when the DGP is not known, it is instructive to use all of these tests and, depending on the specific objective of the exercise, select the breakdate based on an appropriate rule. The rule used here is to select all the breakdates that any of these tests have identified, as the *Nominated breakdates* prior to any further validity tests in the *Awarding breakdates* stage.

The above tests were designed primarily for detecting a single breakdate in a series. Therefore, in order to identify multiple breaks in a series, we need to incorporate them in an iterative scheme (algorithm). In this paper,we employ the algorithm proposed by Karoglou (2006b) comprising the following six steps:

1. Calculate the test statistic under consideration using the available data.

2. If the statistic is above the critical value, split the particular sample into two parts at the corresponding point.

3. Repeat steps 1 and 2 for the first segment until no more (earlier) change-points are found.

4. Mark this point as an estimated change-point of the whole series.

5. Remove the observations that precede this point (i.e. those that constitute the first segment).

6. Consider the remaining observations as the new sample and repeat steps 1 to 5 until no more change-points are found.[14]

This algorithm is implemented with each of the seven test statistics mentioned above (i.e. *I&T*, SAC_1, SAC_2^{BT}, SAC_2^{VH}, $K\&L_{BT}$, $K\&L_{VH}$, *LTM*), and is applied to each series in (both) ascending and descending time order so as to avoid potentially existing masking effects. The *nominated* breakdates for each series are simply all those which have been detected in both directional cases.

The Awarding breakdates stage

Following the nomination of the potential breakdates outlined in the preceding section, this stage serves as a screening process and robustness check. The method is used to decide whether a nominated breakdate is *indeed* a breakdate. Initially, we simply assume that all nominations are breakdates. In fact, one can infer that this is what the traditional paradigm on monetary-variability implicitly suggests. A more elaborate, but more robust method is to compare, statistically, the distributions of each pair of contiguous segments. In this paper, we focus on the mean and/or the varianceof contiguous segments. If both are statistically equal then we can assume that the two segments come from the same distribution,[15] in which case, we unite the two segments into one. If either the mean or the variance of each segment is statistically different from the mean or the variance of its contiguous segment then we *award* the breakdate property to the hitherto *nominated* breakdate. Consequently,application of this method results in a subset of the *nominated* breakdates, which will include only those breakdates that introduce a change in the mean and/or the variance. These are then deemed to be the detected breakdates of the *Nominating-Awarding* procedure.

Finally, equality of the means is tested by the standard *t*-test and the equality of the variances by the standard *F*-test, the *Siegel-Tukey* test with continuity correction (Siegel and Tukey, 1960; Sheskin, 1997), the adjusted *Bartlett* test (seeSokal and Rohlf, 1995; Judge *et al*., 1985), the *Levene* test (1960) and the Brown-Forsythe test (Brown and Forsythe, 1974).[16] It is important that we test the homogeneity of variances with more than one method because of the variations in the properties of each test. For example, on the one hand, the standard *F*-test, although quite powerful, requires sample sizes to be equal and is also sensitive to departures from normality. The *Siegel-Tukey* test, on the other hand, although less sensitive to such departures does not require the equality of sample sizes, assumes independence in the samples, and equal medians. The original *Bartlett* test is also robust when the sample sizes are not equal, however it is sensitive to departures from normality and for that reason we employ its adjusted version which uses a correction factor for the critical values and the arc-sine square-root transformation of the data, in order to conform with the normality assumption. The *Levene* test, an alternative to the *Bartlett* test, is less sensitive to departures from normality while the *Brown-Forsythe* test(1974), a variant of the *Levene* test, uses the median instead of the mean to improve the performance (i.e. size and power) of the test when the underlying distributions are skewed. Using such a battery of tests requires us to employ a decision rule in order be able to draw coherent conclusions, especially when these tests produce conflicting results. The decision rule used in this paper is that if *any* two of these tests reject the null (i.e. the means and/or variances are not equal) then the segments are not united — in other words, the starting date of the second segment is identified as a breakdate.

4. Data and Empirical Results

The dataset used in this paper comprises monthly data for MoneyBase, M0, and Reserve Money of 13 member states of the Franc zone extracted from the International Monetary Fund's International Financial Statistics (IFS) database and spanning the period1989:11—2002:09.[17] We note that the M0 data for each country is the value of notes and coins withdrawn from bank branches in that country, net of the value deposited. Money withdrawn from country *i* can be spent in country *j* making the tracking of the conventional M0 (volume of notes and coins in circulation) difficult. There have been some attempts by the central banks to track the movement of cash across national borders, primarily due to large cross-border movements (particularly, migration and remittances), however these have been largely unsuccessful and any-policy deductions made in this paper should take this into consideration.[18] The west-African member states included are Benin (*Ben*), Burkina-Faso (*BFaso*), Côte d'Ivoire (*Civ*), Mali (*Mal*), Niger (*Ner*), Senegal (*Sen*) and Togo (*Tog*), jointly referred to as UEMOA; while the central-African member states are Cameroon (*Cam*), Central African Republic (*CAR*), Chad (*Chd*), Congo Republic (*Con*), Equatorial Guinea (*GEQ*), and Gabon (*Gab*), often jointly referred to as CEMAC.[19]

Table 1: Augmented Dickey-Fuller (ADF) stationarity tests on Δlog(M0), Δlog(Reserve Money) and Δlog(Money Base) across member states.

	Δlog M0	*Δlog(Reserve Money)*	*Δlog(Money Base)*
Ben	-7.01(1)	-11.04(1)	-14.78(0)
BFaso	9.99(0)	13.68(0)	12.11(0)
Cam	-13.37(0)	-14.43(0)	-14.92(0)
CAR	-10.61(0)	-14.96(0)	- 9.74(0)
Cgo	-16.23(0)	-14.42(0)	-13.36(0)
Civ	- 7.47(2)	-11.38(1)	- 9.49(0)
Gab	-19.26(0)	-15.92(0)	-17.12(0)
GEQ	-11.92(2)	-13.63(0)	-11.70(0)
Mal	-14.72(0)	-15.22(0)	-13.40(0)
Ner	-18.79(0)	-17.03(0)	-18.48(0)
Sen	-11.39(0)	-15.49(0)	-11.70(0)
Tcd	-10.46(0)	-14.61(0)	-10.78(0)
Tog	-7.43(1)	-11.40(1)	-17.21(0)

Notes: The null hypothesis of a unit-root is rejected in all cases at the 1% level. Numbers in parentheses represent selectedlag order based on the Schwartz Information Criterion (SIC) with a maximum lag length of 3.

Table 2: Correlation of Money Base Series Across Member States

	Ben	*BFaso*	*Civ*	*Mal*	*Ner*	*Sen*	*Tog*	*Cam*	*CAR*	*Ted*	*Cgo*	*GEQ*
BFaso	0.15											
Civ	-0.01	0.16										
Mal	0.00	0.10	0.04									
Ner	-0.26	0.03	0.04	0.10								
Sen	0.24	0.27	0.26	0.07	0.07							
Tog	0.03	-0.04	0.13	0.21	0.11	0.11						
Cam	0.17	0.04	0.06	0.06	-0.06	0.17	0.11					
CAR	-0.09	0.09	0.13	0.05	-0.01	0.07	0.01	-0.06				
Tcd	-0.14	0.19	0.04	0.13	-0.04	0.17	0.08	-0.01	0.08			
Cgo	0.07	0.14	0.37	0.12	0.05	0.24	0.14	0.19	0.07	-0.01		
GEQ	0.05	0.01	0.16	0.00	-0.06	-0.03	0.14	0.12	0.09	0.07	0.08	
Gab	0.09	0.16	0.19	-0.02	0.03	0.24	0.06	0.12	0.23	0.13	0.24	0.13

Note: Entries in the top right half of the matrix have been ignored since they are a mirror image of the bottom left section.

Table 3: Correlation of M0 Series Across Member States

	Ben	*BFaso*	*Civ*	*Mal*	*Ner*	*Sen*	*Tog*	*Cam*	*CAR*	*Ted*	*Cgo*	*EQ*
BFaso	0.04											
Civ	0.05	0.18										
Mal	-0.09	0.04	0.19									
Ner	-0.24	0.04	0.09	0.00								
Sen	0.26	0.36	0.57	0.12	-0.08							
Tog	-0.01	-0.12	0.11	0.13	0.06	0.12						
Cam	0.29	0.19	0.41	0.09	-0.01	0.36	0.11					
CAR	0.08	0.08	0.21	0.12	0.04	0.16	0.07	-0.11				
Tcd	-0.17	0.05	0.03	0.16	-0.04	0.12	0.18	-0.05	0.00			
Cgo	0.14	0.16	0.35	0.01	0.09	0.39	0.21	0.50	0.00	0.01		
GEQ	0.07	0.06	0.21	0.03	-0.05	0.09	0.09	0.06	0.09	0.06	0.10	
Gab	0.14	0.09	0.27	0.02	-0.01	0.30	0.15	0.20	0.19	0.06	0.41	0.16

Note: Entries in the top right half of the matrix have been ignored since they are a mirror image of the bottom left section.

Table 4: Correlation of Reserve Money Across Member States

	Ben	*BFaso*	*Civ*	*Mal*	*Ner*	*Sen*	*Tog*	*Cam*	*CAR*	*Ted*	*Cgo*	*GEQ*
BFaso	0.19											
Civ	0.18	0.12										
Mal	-0.05	0.15	-0.18									
Ner	-0.05	0.29	0.18	0.02								
Sen	0.19	0.17	-0.01	0.22	0.26							
Tog	-0.09	0.08	-0.04	0.01	-0.08	-0.06						
Cam	0.04	0.06	0.05	-0.10	0.00	0.00	0.05					
CAR	0.05	0.03	0.17	0.01	-0.07	-0.05	0.07	0.24				
Tcd	-0.13	0.03	-0.14	0.08	-0.10	0.06	0.03	-0.08	0.00			
Cgo	0.00	0.08	0.15	-0.02	-0.04	-0.08	0.08	-0.01	0.06	-0.11		
GEQ	-0.12	-0.09	-0.01	0.07	0.12	-0.03	0.02	0.10	0.04	-0.11	-0.03	
Gab	-0.04	0.03	0.10	0.08	0.01	0.10	-0.11	0.17	0.19	-0.04	-0.04	0.01

Note: Entries in the top right half of the matrix have been ignored since they are a mirror image of the bottom left section.

Table 1 presents the basic descriptive statistics of the log-differences of the data. Note also that the data to be analysed in this paper are in log-differences. In addition, Tables 2 - 4 show the cross-country correlations between the monetary variables, all of which the Central Bank monetary authorities may target with monetary policy. The monetary variables appear to be uncorrelated, even for countries within each of the sub-unions (UEMOA and CEMAC). This preliminary observation is important and may be interpreted as signalling sub-optimality of a single zonal policy; especially when there is limited scope for policy formulation at the country level. Monetary variability across member states may therefore vary significantly — this issue is tested empirically later in the paper.

Breakdates in the monetary variables

Our findings suggest that there are no significant breaks in the *means* of the series in either the pre- or post-devaluation periods (see Table 5). In fact, for all the series and across all the member states, the null of equal means is rejected only for the two periods in the Money Base series of *Cam* and only at the 10 per cent significance level. The overwhelming support for equal means in the money variables over the pre- and post-devaluation periods may be attributed to the administrative structures of the Zone, which are designed (at least, in principle) to 'harmonise' the effects of monetary policy of member states.[20]

Table 5: Tests for Significantly Different Means in the Pre- and Post Devaluation Period

	Δlog(Money Base)			*Δlog(M0)*			*Δlog(Reserve Money)*		
	pre-	post-	*t*-test	pre-	post-	*t*-test	pre-	post-	*t*-test
Ben	0.0168	0.0087	0.49	-0.0005	0.0099	0.45	0.0345	0.0048	0.83
BFaso	0.0083	0.0002	1.09	0.0078	-0.0028	1.47	0.0092	0.0069	0.09
Civ	0.0032	0.0090	0.49	0.0039	0.0067	0.25	-0.0051	0.0168	0.38
Mal	0.0071	0.0111	0.28	0.0058	0.0094	0.23	0.0083	0.0154	0.21
Ner	-0.0002	-0.0007	0.02	0.0039	-0.0025	0.31	-0.0064	0.0051	0.30
Sen	-0.0037	0.0053	0.70	0.0051	0.0025	0.19	-0.0193	0.0113	0.73
Tog	-0.0106	0.0071	1.30	-0.0152	0.0076	1.14	-0.0092	0.0058	0.44
Cam	-0.0092	0.0127	1.86***	-0.0060	0.0069	1.13	-0.0223	0.0214	1.51
CAR	0.0053	-0.0012	1.17	0.0053	-0.005	1.03	0.0044	-0.0150	0.24
Tcd	-0.0037	0.0115	1.26	0.0012	0.0120	0.86	-0.0348	0.0094	0.96
Cgo	0.0060	0.0090	0.22	0.0032	0.0076	0.37	0.0267	0.0131	0.35
GEQ	-0.0138	0.0244	0.92	-0.0175	0.0180	0.51	-0.0090	0.0389	0.83
Gab	0.0028	0.0021	0.04	0.0016	0.0058	0.37	0.0099	-0.0064	0.35

Notes: In this table, *** indicates rejection of the null of no significant difference in the means of thetwo periods at the 10% level of significance.

Tables 6 - 8 report the number and timing of the detected breaks in the variance of the Money Base, M0 and Reserve Money respectively (after the *Nominating breakdates stage*) while Tables 16- 21 report the corresponding results after the *Awarding breakdates stage*. Finally, Tables 9 - 15 report the alternative measures of volatility used in this paper to identify the variances in the pre- and post-official devaluation periods, and also in each of the identified regimes. Although we find no evidence of significant breaks in the mean of the series, the results in Tables 6 - 8 underscore the importance of investigating breaks in both the mean and the variance of series used in empirical applications.

Overall, the results confirm that neighbouring (*nominated*) segments, as reported in the Columns 2 - 7 of Tables 6 - 8, have statistically significantly different variances, typically at the 5 per cent level. Except for four countries, (*CAR*, *Civ*, *Cgo* and *Tcd*), the variances in the pre- and post- official currency devaluation periods are statistically different at the 5 per cent level for both the Money Base and M0 series. For Gab, there appears to be no statistical difference in the variances in the pre- and post-currency devaluation periods for the Money Base alone. A similar scenario is observed for both *Sen* and *Tog* when we consider M0 alone. With respect to Reserve Money, excepting *CAR, Civ, Cam* and *Gab*, the variances in the pre- and post-devaluation periods are all found to be statistically different. Therefore, from a broader point of view, out of the 13 member states, after imposing the breakdate and splitting the data into the pre- and post-official currency devaluation periods (with 50 and 91 observations respectively), we detect a statistically significant break (at the 5% level) in the variance for 8 member states for the Money Base series (Table 6); 7 for the M0 series (Table 7); and 9 for the Reserve Money series (Table 8). When we do not impose the breakdate but instead we detect the changes non-parametrically (Columns 2 - 7), the evolution of volatility appears completely different.

Table 6: Detected Structural Changes in Δlog(Money Base).

Regimes	*1*	*2*	*3*	*4*	*5*	*6*	*pre-*	*post-*
Ben	0.050(56)	**0.117(96)**	.	.	.	.	0.044	**0.113**
BFaso	.	.	.	.	.	.	0.035	**0.047**
Civ	.	.	.	.	.	.	0.063	0.070
Mal	0.0484(56)	**0.0774(43)**	0.1213(39)	.	.	.	0.048	**0.092**
Ner	0.043(54)	**0.079(44)**	0.160(48)	.	.	.	0.039	**0.131**
Sen	0.065(99)	0.082(44)	.	.	.	.	0.061	**0.078**
Tog	0.039(49)	**0.101(22)**	0.079(77)	.	.	.	0.039	**0.092**
Cam	0.069(91)	0.061(61)	.	.	.	.	0.042	**0.077**
CAR	0.043(77)	**0.028(75)**	.	.	.	.	0.035	**0.030**
Tcd	0.052(48)	**0.118(24)**	0.067(47)	**0.029(18)**	.	.	0.062	**0.072**
Cgo	0.058(119)	**0.146(15**)	0.061(18)	.	.	.	0.067	0.080
GEQ	0.388(38)	0.117(66)	0.173(48)	.	.	.	0.349	0.140
Gab	.	.	.	.	.	.	0.087	0.082

Notes: Along a given row, a bold font indicates a detected structural change relative to the preceding segment. A '.' indicates no break detection using the algorithm.

Table 7: Detected Structural Changes in Δlog(M0).

Regimes	*1*	*2*	*3*	*4*	*5*	*6*	*pre-*	*post-*
Ben	0.082(49)	**0.153(52)**	0.306(14)	**0.116(13)**	0.055(20)	.	0.088	**0.151**
BFaso	0.034(99)	0.040(49)	.	.	.	.	0.031	**0.046**
Civ	.	.	.	.	.	.	0.061	0.066
Mal	.	.	.	.	.	.	0.072	**0.096**
Ner	0.026(29)	**0.053(17)**	0.091(45)	**0.177(42)**	.	.	0.050	**0.142**
Sen	.	.	.	.	.	.	0.078	0.071
Tog	,	.	.	.	.	.	0.125	**0.092**
Cam	0.044(58)	**0.076(92)**	.	.	.	.	0.043	**0.075**
CAR	.	.	.	.	.	.	0.034	0.032
Tcd	0.046(47)	**0.129(23)**	0.066(48)	**0.024(18)**	.	.	0.064	0.074
Cgo	.	.	.	.	.	.	0.070	0.067
GEQ	0.660(46)	**0.184(12)**	**0.139(54)**	.	.	.	0.636	**0.136**
Gab	0.080(74)	**0.050(77)**	.	.	.	.	0.078	**0.056**

Notes: Along a given row, a bold font indicates a detected structural change relative to the preceding segment. A '.' indicates no break detection using the algorithm.

Table 8: Detected Structural Changes in Δlog(Reserve Money).

Regimes	*1*	*2*	*3*	*4*	*5*	*6*	*pre-*	*post-*
Ben	0.069 (21)	0.055(35)	**0.257(94)**	.	.	.	0.064	**0.250**
BFaso	0.089(58)	**0.190(84)**	.	.	.	.	0.088	**0.167**
Civ	0.030(78)	**0.575(21)**	0.245(42)	.	.	.	0.291	0.342
Mal	0.070(54)	**0.242(94)**	.	.	.	.	0.067	**0.231**
Ner	0.065(40)	**0.138(13)**	0.235(18)	0.337(36)	**0.206(13)**	**0.182(22)**	0.076	**0.262**
Sen	0.129(54)	**0.175(20)**	0.400(17)	0.262(61)	.	.	0.127	**0.280**
Tog	0.044(40)	0.060(17)	**0.241(41)**	**0.242(54)**	.	.	0.051	**0/240**
Cam	0.173((54)	**0.165(98)**	.	.	.	.	0.168	0.163
CAR	0.416(99)	**0.557(53)**	.	.	.	.	0.391	0.490
Tcd	0.343(54)	**0.228(98)**	.	.	.	.	0.312	**0.230**
Cgo	0.256(33)	**0.208(119)**	.	.	.	.	0.251	**0.203**
GEQ	0.466(32)	**0.291(117)**	.	.	.	.	0.389	**0.294**
Gab	0.305(66)	**0.240(86)**	.	.	.	.	0.289	0.255

Note: Along a given row, a bold font indicates a detected structural change relative to the preceding segment. A '.' indicates no break detection using the algorithm.

Overall, the results confirm that neighbouring (nominated) segments, as reported in Columns 2 - 7 of Tables 6 - 8, have statistically significant different variances, typically at the 5 per cent level. Except for four countries, (*CAR, Civ, Cgo* and *Tcd*), the variances in the pre- and post- official currency devaluation periods are statistically different at the 5 per cent level for both the Money Base and M0 series. For *Gab*, there appears to be no statistical difference in the variances in the pre- and post-currency devaluation periods for the Money Base alone. A similar scenario is observed for both *Sen* and *Tog* when we consider M0 alone. With respect to Reserve Money, excepting *CAR, Civ, Cam* and *Gab*, the variances in the pre- and post-devaluation periods are all found to be statistically different. Therefore, from a broader point of view, out of the 13 member states, after imposing the breakdate and splitting the data into the pre- and post-official currency devaluation periods (with 50 and 91 observations respectively), we detect a statistically significant break (at the 5 per cent level) in the variance for 8 member states for the Money Base series (Table 6); 7 for the M0 series (Table 7); and 9 for the Reserve Money series (Table 8). When we do not impose the breakdate but instead we detect the changes non-parametrically (Columns 2 - 7), the evolution of volatility appears completely different.

In particular, our results confirm the following:

(i). In the case of the Money Base, there are significant breaks for *BFaso, Civ, Sen, Cam* and *Gab*; one break for *Ben* and *CAR*; two breaks for *Mal, Ner, Tog, Cgo*, and *GEQ* and three breaks for *Tcd*.

(ii). In the case of M0, there are no breaks for *BFaso*, *Civ, Sen, Mal, Ner, Tog,* and *Cgo*; one break for *Cam, Gab* and *GEQ*, *Ben* and *CAR*; three breaks for *Ner* and *Tcd*; and four breaks only in *Ben*.

(iii). Finally, for Reserve Money, there are no breaks for *Cam*; there is one break for *Ben, BFaso, Mal, Tog, CAR, Tcd, Cgo, GEQ* and *Gab*; two for *Civ*; and three for *Ner and Sen*.

The evolution of monetary variability

Table 9: Volatility Measures for Δlog(Money Base).

Money Base	*Obs.*	*Mean*	*Std. dev.*	*VARHAC*	*Skewness*	*Kurtosis*
Ben	152	0.0108	0.0990	0.0824	-0.09	5.56
Regime 1	56	0.0099	0.0475	0.0462	-0.42	2.81
Regime 2	96	0.0113	0.1192	0.1147	-0.07	4.15
Pre-	50	0.0168	0.0430	0.0418	-0.32	2.77
Post-	91	0.0087	0.1128	0.1126	0.04	4.47
Bfaso	152	0.0026	0.0458	0.0466	0.70	4.74
Pre-	50	0.0084	0.0348	0.0358	-0.53	3.75
Post-	91	0.0002	0.0462	0.0453	-0.15	2.88
Civ	152	0.0091	0.0697	0.0581	1.04	3.82
Pre-	50	0.0031	0.0620	0.0868	1.17	3.96
Post-	91	0.0090	0.0701	0.0526	1.05	4.15
Mal	152	0.0075	0.0810	0.0450	0.28	12.11
Regime 1	56	0.0103	0.0479	0.0338	0.93	8.95
Regime 2	43	-0.0012	0.0765	0.0558	-0.65	3.89
Regime 3	39	0.0057	0.1198	0.0575	0.52	8.70
Pre-	50	0.0070	0.0476	0.0309	1.17	10.36
Post-	91	0.0110	0.0915	0.0622	0.42	11.19
Ner	152	-0.0024	0.1053	0.0705	0.71	8.24
Regime 1	54	0.0003	0.0422	0.0421	0.41	3.22
Regime 2	44	-0.0121	0.0782	0.0403	0.43	2.71
Regime 3	48	0.0035	0.1583	0.0990	0.55	4.70
Pre-	50	-0.0003	0.0387	0.0383	-0.13	2.14
Post-	91	-0.0006	0.1305	0.0844	0.59	5.75
Sen	152	0.0045	0.0721	0.0465	0.60	3.73
Regime 1	99	0.0003	0.0654	0.0651	1.06	4.65
Regime 2	44	0.0095	0.0812	0.0845	-0.07	3.02
Pre-	50	-0.0036	0.0606	0.0593	1.06	4.91
Post-	91	0.0053	0.0775	0.0790	0.50	3.57
Tog	152	0.0010	0.0798	0.0574	0.89	6.19
Regime 1	49	-0.0104	0.0388	0.0610	0.08	2.44
Regime 2	22	0.0027	0.0989	0.0477	0.71	3.01
Regime 3	77	0.0027	0.0722	0.0566	0.04	3.49
Pre-	50	-0.0107	0.0385	0.0627	0.09	2.48
Post-	91	0.0071	0.0917	0.0639	0.61	4.97

cont.....

Table 10: Volatility Measures for Δlog(Money Base) *...cont*

Money Base	*Obs.*	*Mean*	*Std. dev.*	*VARHAC*	*Skewness*	*Kurtosis*
Cam	152	0.0068	0.0658	0.0724	-0.18	3.73
Regime 1	91	0.0028	0.0690	0.0988	0.18	3.85
Regime 2	61	0.0126	0.0602	0.0361	-0.57	3.56
Pre-	50	-0.0091	0.0416	0.0389	-0.42	2.51
Post-	91	0.0126	0.0762	0.0588	-0.20	3.25
CAR	152	0.0047	0.0366	0.0473	0.68	6.54
Regime 1	77	0.0116	0.0426	0.0560	0.61	5.53
Regime 2	75	-0.0024	0.0274	0.0279	-0.19	4.99
Pre-	50	0.0053	0.0345	0.0339	-0.34	3.73
Post-	91	-0.0012	0.0301	0.0298	-0.07	5.07
Tcd	152	0.0059	0.0705	0.0825	0.35	5.42
Regime 1	48	-0.0040	0.0513	0.0523	-0.53	3.76
Regime 2	24	0.0171	0.1151	0.1875	0.04	2.69
Regime 3	47	-0.009	0.0664	0.0461	0.23	4.66
Regime 4	18	0.0076	0.0280	0.0285	1.55	5.05
Pre-	50	-0.0036	0.0611	0.0627	-0.18	4.43
Post-	91	0.0115	0.0714	0.0801	0.69	6.15
Cgo	152	0.0094	0.0731	0.0736	2.08	14.01
Regime 1	119	0.0060	0.0583	0.0580	0.63	4.35
Regime 2	15	0.0599	0.1411	0.1488	1.62	6.00
Regime 3	18	-0.0103	0.0587	0.0561	0.33	3.27
Pre-	50	0.0060	0.0660	0.0656	0.46	4.03
Post-	91	0.0089	0.0792	0.0802	2.64	15.97
GEQ	152	0.0147	0.2289	0.0888	0.26	12.86
Regime 1	38	-0.0235	0.3834	0.2118	0.40	6.40
Regime 2	66	0.0308	0.1164	0.0683	0.32	3.18
Regime 3	48	0.0288	0.1714	0.1269	0.59	3.55
Pre-	50	-0.0139	0.3457	0.1813	0.36	7.35
Post-	91	0.0244	0.1393	0.1160	0.63	4.62
Gab	152	0.0076	0.0860	0.0622	0.02	3.18
Pre-	50	0.0027	0.0860	0.0599	-0.16	3.18
Post-	91	0.0021	0.0811	0.0572	0.01	3.37

Note: Pre- and Post- indicate the periods before and after the devaluation date respectively.

Table 11: Volatility Measures for Δlog(M0).

M0	*Obs.*	*Mean*	*Std. dev.*	*VARHAC*	*Skewness*	*Kurtosis*
Ben	152	0.0115	0.1408	0.1648	0.27	5.94
Regime 1	49	-0.0054	0.0809	0.0814	-0.31	3.18
Regime 2	52	0.0253	0.1513	0.1488	0.20	4.07
Regime 3	14	0.0361	0.2944	0.1867	-0.11	2.15
Regime 4	13	0.0382	0.1113	0.0734	-0.29	2.55
Regime 5	20	-0.0053	0.0540	0.0567	0.45	2.27
Pre-	50	-0.0005	0.0871	0.0883	0.02	3.53
Post-	91	0.0100	0.1499	0.1334	-0.03	5.72
Bfaso	152	0.0022	0.0408	0.0470	-0.41	4.53
Regime 1	99	0.0119	0.0335	0.0337	0.13	4.24
Regime 2	49	-0.0088	0.0400	0.0168	0.16	3.74
Pre-	50	0.0079	0.0305	0.0299	-0.36	3.62
Post-	91	-0.0027	0.0456	0.0554	-0.23	4.17
Civ	152	0.0075	0.0635	0.0440	1.21	3.88
Pre-	50	0.0039	0.0600	0.1001	1.27	3.77
Post-	91	0.0067	0.0654	0.0510	1.23	4.00
Mal	152	0.0093	0.0970	0.0696	0.62	26.33
Pre-	50	0.0058	0.0709	0.0997	0.75	6.40
Post-	91	0.0094	0.0961	0.0697	0.54	28.45
Ner	152	-0.0009	0.1141	0.0752	0.05	8.44
Regime 1	29	-0.0046	0.0260	0.0257	0.67	3.93
Regime 2	17	-0.0043	0.0513	0.0261	-0.44	2.33
Regime 3	45	0.0053	0.0902	70.0488	0.22	3.80
Regime 4	42	-0.0082	0.1748	0.0615	0.14	4.90
Pre-	50	0.0038	0.0489	0.0501	1.07	6.65
Post-	91	-0.0026	0.1415	0.0892	0.05	5.90
Sen	152	0.0057	0.0736	0.0413	1.49	5.79
Pre-	50	0.0050	0.0768	0.0860	1.31	4.83
Post-	91	0.0026	0.0705	0.0529	1.65	6.73
Tog	152	0.0076	0.1304	0.1124	1.64	12.72
Pre-	50	-0.0151	0.1233	0.1178	-0.38	3.94
Post-	91	0.0075	0.1052	0.0669	0.80	5.56

cont.....

Table 12: Volatility Measures for Δlog(M0) *...cont*

M0	*Obs.*	*Mean*	*Std. dev.*	*VARHAC*	*Skewness*	*Kurtosis*
Cam	152	0.0035	0.0649	0.0654	0.64	4.54
Regime 1	58	-0.0047	0.0437	0.0420	-0.22	2.92
Regime 2	92	0.0083	0.0753	0.0754	0.58	3.72
Pre-	50	-0.0060	0.0427	0.0404	-0.25	3.11
Post-	91	0.0070	0.0745	0.0753	0.61	3.90
CAR	152	0.0046	0.0340	0.0400	-0.17	4.50
Pre-	50	0.0053	0.0355	0.0338	-0.38	3.88
Post-	91	-0.0005	0.0317	0.0311	-0.18	5.53
Tcd	152	0.0069	0.0716	0.0895	0.32	5.79
Regime 1	47	0.0047	0.0461	0.0472	-0.40	3.88
Regime 2	23	-0.0043	0.1266	0.2435	0.21	2.48
Regime 3	48	-0.0001	0.0650	0.0385	1.00	6.70
Regime 4	18	0.0075	0.0232	0.0253	0.78	4.78
Pre-	50	0.0011	0.0633	0.0652	-0.47	5.26
Post-	91	0.0119	0.0738	0.0880	0.62	6.19
Cgo	152	0.0077	0.0674	0.0480	0.24	3.71
Pre-	50	0.0032	0.0690	0.0678	0.24	3.62
Post-	91	0.0076	0.0670	0.0491	0.38	3.90
GEQ	152	0.0129	0.3788	0.1205	-0.25	11.03
Regime 1	46	-0.0159	0.6525	0.2007	-0.03	4.10
Regime 2	12	0.0525	0.1766	0.0835	-0.01	2.56
Regime 3	54	0.0134	0.1373	0.0787	0.00	6.92
Pre-	50	-0.0174	0.6297	0.1949	-0.02	4.35
Post-	91	0.0179	0.1353	0.0811	-0.12	5.82
Gab	152	0.0070	0.0659	0.0353	0.00	5.59
Regime 1	74	0.0076	0.0796	0.0398	0.05	4.72
Regime 2	77	0.0058	0.0497	0.0294	-0.23	4.33
Pre-	50	0.0015	0.0776	0.0257	0.23	4.11
Post-	91	0.0058	0.0561	0.0291	-0.78	6.31

Note: Pre- and Post- indicate the periods before and after the devaluation date respectively.

Table 13: Volatility Measures for Δlog(Reserve Money)

Reserve money	*Obs.*	*Mean*	*Std. dev.*	*VARHAC*	*Skewness*	*Kurtosis*
Ben	152	0.0085	0.2064	0.1548	-0.67	4.23
Regime 1	21	0.0641	0.0672	0.0695	-0.87	3.03
Regime 2	35	0.0049	0.0542	0.0567	-0.54	2.54
Regime 3	94	0.0008	0.2558	0.1548	-0.48	2.82
Pre-	50	0.0345	0.0628	0.0625	-0.23	2.37
Post-	91	0.0048	0.2489	0.1549	-0.35	2.56
Bfaso	152	0.0033	0.1560	0.1409	-0.63	6.54
Regime 1	58	0.0091	0.0882	0.0895	0.45	3.37
Regime 2	84	-0.0070	0.1889	0.1329	-0.57	5.16
Pre-	50	0.0092	0.0875	0.0890	0.57	3.75
Post-	91	0.0070	0.1660	0.1232	0.08	2.91
Civ	152	0.0161	0.3296	0.1448	0.17	5.10
Regime 1	78	0.0039	0.3029	0.1928	0.28	3.03
Regime 2	21	0.0238	0.5612	0.5604	0.24	3.03
Regime 3	42	0.0211	0.2419	0.2479	-0.86	5.73
Pre-	50	-0.0050	0.2877	0.0824	0.05	2.81
Post-	91	0.0169	0.3406	0.1442	0.18	6.04
Mal	152	0.0047	0.1951	0.1596	0.81	7.47
Regime 1	54	0.0072	0.0688	0.0635	0.00	2.80
Regime 2	94	0.0025	0.2403	0.1887	0.72	5.25
Pre-	50	0.0083	0.0661	0.0598	0.10	2.96
Post-	91	0.0153	0.2302	0.1623	0.94	5.69

Note: Pre- and Post- indicate the periods before and after the devaluation date respectively.

Table 14: Volatility Measures for Δlog(Reserve Money) *...cont*

Reserve money	*Obs.*	*Mean*	*Std. dev.*	*VARHAC*	*Skewness*	*Kurtosis*
Ner	152	-0.0047	0.2167	0.1579	0.09	3.97
Regime 1	40	0.0037	0.0644	0.0606	-0.89	3.41
Regime 2	13	-0.0328	0.1322	0.0581	0.97	3.25
Regime 3	18	-0.0645	0.2288	0.0549	0.07	2.16
Regime 4	36	0.0168	0.3320	0.2245	-0.12	2.33
Regime 5	13	-0.0290	0.1982	0.1922	0.73	3.41
Regime 6	22	0.0386	0.1783	0.1256	0.22	2.51
Pre-	50	-0.0065	0.0749	0.0735	-0.40	2.63
Post-	91	0.0050	0.2611	0.1789	0.08	2.89
Sen	152	0.0030	0.2325	0.1049	0.12	5.44
Regime 1	54	-0.0091	0.1279	0.1240	-0.41	4.01
Regime 2	20	-0.0035	0.1703	0.1665	0.40	1.82
Regime 3	17	-0.0425	0.3879	0.2179	0.73	3.70
Regime 4	61	0.0286	0.2596	0.1178	-0.39	3.71
Pre-	50	-0.0194	0.1258	0.1212	-0.40	4.16
Post-	91	0.0113	0.2788	0.1036	0.06	4.25
Tog	152	-0.0058	0.1922	0.1302	0.17	4.22
Regime 1	40	-0.0020	0.029	0.0430	-0.29	2.53
Regime 2	17	-0.0475	0.0586	0.0616	0.93	3.88
Regime 3	41	-0.0170	0.2377	0.1796	0.23	2.46
Regime 4	54	0.0130	0.2400	0.1552	-0.05	3.08
Pre-	50	-0.0092	0.0489	0.0311	0.02	2.62
Post-	91	0.0058	0.2386	0.1487	0.06	2.84

Note: Pre- and Post- indicate the periods before and after the devaluation date respectively.

Table 15: Volatility Measures for Δlog(Reserve Money) ...cont

Reserve money	*Obs.*	*Mean*	*Std. dev.*	*VARHAC*	*Skewness*	*Kurtosis*
Cam	152	0.0117	0.1688	0.1428	0.22	3.04
Regime 1	54	-0.0067	0.1757	0.1425	0.34	2.98
Regime 2	98	0.0219	0.1639	0.1317	0.17	3.13
Pre-	50	-0.0224	0.1659	0.1168	0.30	3.18
Post-	91	0.0215	0.1618	0.1296	0.06	3.12
CAR	152	0.0130	0.4667	0.3496	0.39	3.85
Regime 1	99	0.0107	0.4142	0.4778	0.44	5.01
Regime 2	53	0.0172	0.5514	0.1710	0.32	2.68
Pre-	50	0.0043	0.3866	0.3094	0.58	4.87
Post-	91	-0.0149	0.4873	0.2760	0.23	3.41
Tcd	152	0.0017	0.2725	0.2260	0.05	3.47
Regime 1	54	-0.0072	0.3401	0.3477	-0.02	2.88
Regime 2	98	0.0066	0.2266	0.1764	0.26	3.16
Pre-	50	-0.0348	0.3086	0.3157	-0.40	2.46
Post-	91	0.0095	0.2293	0.1761	0.30	3.09
Cgo	152	0.0187	0.2175	0.1522	0.96	5.14
Regime 1	33	0.0178	0.2522	0.1974	0.38	2.62
Regime 2	119	0.0190	0.2069	0.1388	1.24	6.42
Pre-	50	0.0267	0.2486	0.2546	0.42	2.61
Post-	91	0.0130	0.2021	0.2064	1.51	8,12
GEQ	152	0.0169	0.3314	0.1544	0.19	5.18
Regime 1	32	-0.0084	0.4584	0.4619	0.21	4.07
Regime 2	117	0.0284	0.2898	0.2922	0.21	4.54
Pre-	50	-0.0091	0.3847	0.3802	0.24	5.30
Post-	91	0.0389	0.2921	0.2802	0.28	4.90
Gab	152	0.0112	0.2684	0.2015	-0.35	3.67
Regime 1	66	0.0250	0.3026	0.3090	-0.37	3.36
Regime 2	86	0.0007	0,2383	0.1447	-0.39	3.77
Pre-	50	0.0100	0.2858	0.1744	-0.38	3.82
Post-	91	-0.0064	0.2540	0.1690	-0.41	3.60

Note: Pre- and Post- indicate the periods before and after the devaluation date respectively.

Tables 9 - 15 report the main descriptive statistics and the two volatility measures used in this paper to identify the variances in the pre- and post- devaluation periods, and also for each identified regime.

In particular, we can deduce the following from the results in Tables 9 - 10 (Money Base). On the one hand, when January 1994 is imposed as the breakdate, only the results for *GEQ* suggest a significant decrease in volatility in the period following the official currency devaluation date. In addition, for *Civ, Tcd, Cgo* and *Gab* we find no statistical difference between the volatility between the two periods. On the other hand, when we do not impose a break date, the algorithm suggests that multiple regimes actually exist in most cases.

With the exception of *BFaso*, *Civ*, *Sen*, *Cam* and *Gab,* where no significant difference in volatility of the series is found, at least two distinct regimes are found for each of the remaining member states. Of the eight remaining cases where significantly different breaks are determined, only *Tog* and *Tcd* suggest an initial break within two months prior (November 1993) to the official devaluation date. For *Mal* and *Ner*, the initial break occurs within six months (by July 1994) following the official devaluation date, while the initial break occurs later for the other member states. In most of the cases where a significant break is detected, it is suggestive of an increase in volatility of the series, however this is not conclusive as this is not the case for all member states.

In Tables 11-12 (M0), imposing the break date suggests that approximately half of the member states (six out of thirteen) show a significant change in the volatility in M0 between the two periods. However, not imposing a breakdate appears to be more informative, as the procedure indicates a richer evolution of volatility in both the pre-and post-official devaluation periods, which is not captured otherwise. Preliminary tests suggest that as many as five regimes are detected in *Ben*, four in *Tcd* and *Ner*, three in *GEQ* and two in *BFaso, Cam* and *Gab*. Robustness tests, however, show some regimes to be statistically similar (see Tables 7 and 18) at the one per cent level, such as in *Civ, Mal, Sen, Tog, CAR* and *Cgo*.

Tables 14-15 suggest that imposing the January 1994 break date results in significantly different volatilities in the Reserve Money for all member states in the two periods, except *Civ, CAR, Cam* and *Gab*. As with Tables 9 - 12, the identification of volatilities is richer when the (restriction of a) break date is not imposed. As many as six regimes are initially detected in *Ner*, four in *Sen* and *Tog*, three in *Ben* and *Civ* and two in each of the remaining member states. Further tests for statistical difference, however, suggest that some consecutive regimes are not statistically different, at least at the five per cent level (see Tables 6-21). For example, the six regimes detected for Reserve Money in *Ner* is confirmed to be actually four distinct regimes. Furthermore, the volatility in the earlier detected regimes 5 and 6 (beginning in July 1999) is found to decrease to the level detected in regime 2 (ending in June 1993).

Table 16: Robustness Tests for separate segments in Δlog(Money Base) series

	F-test	*Siegel-Tukey*	*Barlett*	*Levene*	*Browne-Forsythe*
Ben	6.82**	4.58**	43.97**	19.39**	19.35**
seg1 - seg2	5.46**	4.26**	39.65**	21.04**	21.04**
Bfaso	1.74**	2.22**	4.55**	5.17**	5.9**
Civ	1.26	0.46	0.85	0.65	0.49
Mal	3.66**	3.97**	22.22**	8.8**	8.47**
seg1-seg2	2.56**	3.46**	10.50**	9.34**	9.32**
seg1-seg3	6.31**	3.05**	36.89**	9.22**	8.73**
seg2-seg3	2.46**	0.09	7.86**	0.95	0.84
Mal	11.26**	5.69**	64.28**	27.3**	27.38**
seg1-seg2	3.45**	3.65**	17.67**	17.63**	14.27**
seg1-seg3	14.11**	5.53**	71.74**	34.17**	33.76**
seg2-seg3	4.09**	3.11**	20.03**	10.64**	10.7**
Sen	1.62**	1.48	3.47*	3.44*	2.81*
seg1-seg2	1.56	1.00	3.11*	2.43	2.59
Tog	5.62**	4.33**	36.74**	19.41**	19.19**
seg1-seg2	6.66**	4.49**	28.76**	29.49**	28.84**
seg1-seg3	3.92**	3.64**	23.2**	16.39**	16.43**
seg2-seg3	1.70	2.11**	2.49	3.14*	3.12*
Cam	3.33**	3.11**	19.39**	12.00**	11.71**
seg1-seg2	1.30	0.03	1.23	0.38	0.49

Notes: In this table, *,**,*** indicates rejection of the null of no significant difference in the variances of the two segments at the 10%, 5% and 1% levels of significance respectively.

Table 17: Robustness Tests for separate segments in Δlog(Money Base) series *...cont*

	F-test	*Siegel-Tukey*	*Barlett*	*Levene*	*Browne-Forsythe*
CAR	1.32	0.10	1.27	0.63	0.60
seg1 - seg2	2.42**	1.14	14.09**	6.00**	5.48**
Tcd	1.36	0.07	1.71	0.31	0.20
seg1-seg2	5.15**	2.63**	22.15**	16.57**	16.3**
seg1-seg3	1.68*	0.86	3.04*	1.26	1.10
seg1-seg4	3.23**	1.89*	6.83**	3.75*	4.24**
seg2-seg3	3.07**	2.13**	10.26**	8.7**	8.6**
seg2-seg4	16.65**	3.16**	26.72**	14.67**	14.8**
seg3-seg4	5.42**	3.06**	12.79**	5.22**	5.33**
Cgo	1.43	0.48	1.90	0.25	0.14
seg1-seg2	6.23**	3.31**	31.87**	17.91**	17.55**
seg1-seg3	1.07	0.76	0.03	0.02	0.00
seg2-seg3	5.84**	1.75*	10.86**	4.59**	4.63**
GEQ	6.22**	4.42**	55.06**	20.95**	20.2**
seg1-seg2	10.98**	4.67**	66.73**	23.18**	22.70**
seg1-seg3	5.03**	3.00**	25.66**	9.39**	9.30**
seg2-seg3	2.18**	1.82*	8.37**	5.11**	4.45**
Gab	1.13	0.28	0.25	0.1	0.09

Notes: In this table, *,**,*** indicates rejection of the null of no significant difference in the variances of the two segments at the 10%, 5% and 1% levels of significance respectively.

Table 18: Robustness Tests for separate segments in Δlog(M0) series

	F-test	*Siegel-Tukey*	*Barlett*	*Levene*	*Browne-Forsythe*
Ben	2.94**	1.96**	15.87**	5.86**	5.87**
seg1-seg2	3.49**	2.76**	17.81**	9.62**	8.77**
seg1-seg3	13.96**	4.51**	45.31**	55.3**	51.99**
seg1-seg4	2.01	1.18	2.58	2.24	1.99
seg1-seg5	2.18**	1.26	3.56*	2.62	2.69
seg2-seg3	4.00**	3.52**	12.09**	16.64**	15.82**
seg2-seg4	1.74	0.35	1.29	0.67	0.63
seg2-seg5	7.61**	2.86**	19.36**	8.97**	8.29**
seg3-seg4	6.95**	2.98**	9.65**	12.3**	11.46**
seg3-seg5	30.39**	4.36**	36.35**	34.78**	31.98**
seg4-seg5	4.37**	1.23	7.91**	6.50**	6.67**
BFaso	2.21**	1.39	8.98**	5.01**	5.11**
seg1-seg2	1.44	2.14**	2.16	1.93	1.59
Civ	1.18	0.42	0.41	0.15	0.19
Mal	1.82**	0.98	5.26**	0.04	0.04
Ner	8.28**	4.46**	51.60**	18.91**	18.82**
seg1-seg2	4.01**	2.34**	10.07**	9.09**	7.68**
seg1-seg3	11.92**	2.57**	37.12**	13.36**	11.13**
seg1-seg4	44.88**	5.42**	70.56**	24.69**	24.70**
seg2-seg3	2.97**	0.88	5.61**	2.02	1.65
seg2-seg4	11.18**	3.57**	21.31**	9.23**	9.36**
seg3-seg4	3.77**	3.11**	17.48**	10.6**	10.94**

Notes: In this table, *,**,*** indicates rejection of the null of no significant difference in the variances of the two segments at the 10%, 5% and 1% levels of significance respectively.

Table 19: Robustness Tests for separate segments in Δlog(M0) series *...cont*

	F-test	*Siegel-Tukey*	*Barlett*	*Levene*	*Browne-Forsythe*
Sen	1.20	1.43	0.52	0.77	0.76
Tog	1.39	1.03	1.73	1.24	1.33
Cam	3.02**	2.14**	16.67**	8.88**	8.82**
seg1-seg2	2.95**	2.30**	18.05**	10.39**	9.99**
CAR	1.12	0.46	0.22	0.32	0.32
Tcd	1.35	0.11	1.34	0.20**	0.20
seg1-seg2	7.71**	3.70**	32.96**	24.23**	23.56**
seg1-seg3	1.99**	0.21	5.32**	1.16	1.20
seg1-seg4	3.83**	2.18**	8.62**	5.56**	4.86**
seg2-seg3	3.88**	2.71**	14.84**	13.41**	13.19**
seg2-seg4	29.50**	3.98**	35.29**	18.92**	18.62**
seg3-seg4	7.61**	2.76**	17.34**	5.33**	5.29**
Cgo	1.07	0.33	0.07	0.09	0.09
GEQ	21.87**	5.78**	142.77**	51.96**	50.29**
seg1-seg2	12.80**	2.27**	16.34**	5.87**	5.85**
seg1-seg3	22.65**	5.07**	93.11**	34.12**	34.03**
seg2-seg3	1.77	1.74*	1.62	2.25	2.25
Gab	1.93**	1.52	7.17**	3.75**	3.52*
seg1-seg2	2.56**	1.41	15.9**	5.43**	5.43**

Notes: In this table, *,**,*** indicates rejection of the null of no significant difference in the variances of the two segments at the 10%, 5% and 1% levels of significance respectively.

Table 20: Robustness Tests for separate segments in Δlog(Reserve Money) series

	F-test	*Siegel-Tukey*	*Barlett*	*Levene*	*Browne-Forsythe*
Ben	15.56**	6.78**	78.23**	55.69**	46.53**
seg1-seg2	1.57	1.44	1.29	1.26	1.19
seg1-seg3	13.96**	4.42**	31.89**	20.91**	17.78**
seg2-seg3	21.90**	6.53**	66.75**	40.04**	34.13**
BFaso	3.57**	4.21**	21.47**	19.66**	19.64**
seg1-seg2	4.56**	4.04**	32.71**	8.34*	18.46**
Civ	1.39	0.76	1.64	0.01	0.01
seg1-seg2	3.56**	2.11**	15.44**	11.81**	7.53**
seg1-seg3	1.55*	2.08**	2.42	3.68*	3.43*
seg2-seg3	5.52**	3.21**	20.86**	15.62**	10.23**
Mal	12.02**	5.76**	67.03**	26.88**	26.91**
seg1-seg2	12.11**	5.96**	72.51**	29.61**	29.88**
Ner	12.06**	5.76**	67.16**	38.53**	37.87**
seg1-seg2	4.45**	2.49**	12.03**	8.74**	6.54**
seg1-seg3	13.01**	3.89**	41.47**	45.37**	35039**
seg1-seg4	26.61**	5.67**	74.59**	46.8**	46.41**
seg1-seg5	10.00**	2.1**	29.47**	18.82**	16.87**
seg1-seg6	7.82**	3.66**	29.44**	22.17**	20.82**
seg2-seg3	2.93**	2.38**	3.53*	5.4**	4.43**
seg2-seg4	5.98**	2.25**	9.93**	8.57**	8.75**
seg2-seg5	2.25	1.08	1.84	1.27	1.26
seg2-seg6	1.76	0.12	1.10	1.21	1.33
seg3-seg4	2.05*	1.06	2.60	2.11	2.19
seg3-seg5	1.30	1.14	0.23	0.87	.69
seg3-seg6	1.66	1.48	1.20	2.08	1.58
seg4-seg5	2.66**	1.91**	3.48*	3.91*	3.94*
seg4-seg6	3.40**	2.24**	8.34**	7.64**	7.48**
seg5-seg6	1.28	0.26	0.23	0.06	0.04

cont....

Notes: In this table, *,**,*** indicates rejection of the null of no significant difference in the variances of the two segments at the 10%, 5% and 1% levels of significance respectively.

Table 21: Robustness Tests for separate segments in Δlog(Reserve Money) series ...cont

	F-test	*Siegel-Tukey*	*Barlett*	*Levene*	*Browne-Forsythe*
Sen	4.87**	4.13**	31.62**	17.06**	17.11**
seg1-seg2	1.83	1.82*	2.74-	4.09**	3.53*
seg1-seg3	9.60**	3.62..	38.61**	23.18**	18.08**
seg1-seg4	4.11**	3.35**	25.19**	1.58**	14.62**
seg2-seg3	5.24**	1.94*	10.91**	5.67**	4.28**
seg2-seg4	2.25**	0.68	3.99**	1.61	1.76
seg3-seg4	2.33**	1.94*	5.13**	3.34*	2.58
Tog	23.58**	7.34**	96.83**	53.98**	52.05**
seg1-seg2	1.93	1.25	2.59	1.78	1.37
seg1-seg3	30.64**	6.37**	81.15**	58.73**	51.64**
seg1-seg4	31.06**	6.25**	84.47**	41.96**	41.28**
seg2-seg3	15.88**	5.18**	26.18**	21.51**	19.07**
seg2-seg4	16.1**	3.36**	26.94**	15.26**	15.19**
seg3-seg4	1.01	0.23	0.00	0.09	0.06
Cam	1.06	0.27	0.06	0.01	0.01
seg1-seg2	1.16	0.08	0.38	0.11	0.07
CAR	1.57*	0.99	3.08*	1.90	1.83
seg1-seg2	1.79**	1.66*	5.96**	5.74**	4.81**
Tcd	1.83**	2.18**	5.99**	6.92**	5.83**
seg1-seg2	2.27**	2.74**	12.09**	11.36**	10.49**
Cgo	1.53	3.67**	2.91*	7.24**	7.37**
seg1-seg2	1.52	2.71**	2.35	4.50**	4.48**
GEQ	1.75**	1.32	5.15**	2.27	2.28
seg1-seg2	2.56**	2.25**	12.53**	8.13**	8.02**
Gab	1.28	0.23	0.97	0.28	0.28
seg1-seg2	1.62**	1.45	4.28**	3.34*	3.34**

Notes: In this table, *,**,*** indicates rejection of the null of no significant difference in the variances of the two segments at the 10%, 5% and 1% levels of significance respectively.

Table 22: Detected Structural Change Dates in UEMOA and CEMAC

	IT	SAC_1	SAC_2^{BT}	SAC_2^{VH}	KL_{BT}	KL_{VH}	*LMT*
CEMAC							
Δlog(M0)	-	-	-	-	-	-	-
Δlog(Money Base)	-	-	-	-	-	-	-
Δlog(Res. Money)	1994:6**	-	-	-	-	-	-
UEMOA							
Δlog(M0)	-	-	-	-	-	-	-
Δlog(Money Base)	1994:9***	-	1994:9**	-	1994:9**	-	-
Δlog(Res. Money)	1994:9***	1994:9***	-	-	-	-	1994:9***
	1997:12**	-	-	-	-	-	-

Notes: Entries marked ***,**indicate detected breakdates at the 1% and 5% levels of significance respectively.

Table 23: Volatility Measures for Δlog(M0), Δlog(Money Base) and Δlog(Reserve Money) in CEMAC and UEMOA areas.

Δlog(M0)	*Obs.*	*Mean*	*Std. dev.*	*VARHAC*	*Skewness*	*Kurtosis*
CEMAC	152	0.005	0.036	0.023	0.52	4.59
Pre-	50	-0.001	0.033	0.021	0.68	4.09
Post-	91	0.008	0.037	0.020	0.43	4.82
UEMOA	152	0.007	0.043	0.026	1.14	4.21
Pre-	50	0.002	0.042	0.039	1.04	3.82
Post-	91	0.009	0.043	0.033	1.18	4.35
Δlog(Money Base)						
CEMAC	152	0.007	0.038	0.042	0.37	3.28
Pre-	50	-0.003	0.033	0.024	-0.09	3.18
Post-	91	0.012	0.039	0.030	0.42	3.03
UEMOA	182	0.006	0.039	0.026	1.34	5.86
Regime 1	58	0.004	0.025	0.039	0.55	2.95
Regime 2	94	0.007	0.045	0.052	1.27	4.90
Pre-	50	0.002	0.025	0.035	0.58	3.14
Post-	91	0.008	0.044	0.052	1.24	4.97
Δlog(Reserve Money)						
CEMAC	152	0.011	0.126	0.141	0.22	3.27
Regime 1	55	0.011	0.151	0.152	0.04	2.78
Regime 2	97	0.011	0.110	0.094	0.45	3.34
Pre-	50	-0.016	0.132	0.097	-0.16	2.83
Post-	91	0.024	0.120	0.119	0.54	3.225
UEMOA	152	0.005	0.122	0.102	-0.18	6.14
Regime 1	58	0.002	0.045	0.042	0.08	2.77
Regime 2	39	-0.017	0.186	0.127	0.14	3.53
Regime 3	55	0.024	0.118	0.122	-0.41	4.14
Pre-	50	0.002	0.041	0.037	0.19	3.02
Post-	91	0.006	0.145	0.121	-0.19	4.49

Notes: Pre- and Post- indicate the periods before and after the devaluation date respectively.

Table 24: Robustness Tests for separate segments in CEMAC and UEMOA

	F-test	*Siegel-Tukey*	*Barlett.*	*Levene*	*Browne-Forsythe*	*t-test*
CEMAC	-	-	-	-	-	
Δlog(M0)	-	-	-	-	-	
Pre-Post	1.19	0.84	0.49	0.002	0.0004	-1.527
Δlog(Money Base)	-	-	-	-	-	
Pre-Post	1.43	0.80	2.00	1.608	1.3992	-2.300**
Δlog(Reserve Money)	-	-	-	-	-	
Pre-Post	1.22	0.99	0.67	0.584	0.6359	-1.851***
Seg1-Seg2	1.91**	2.21**	7.57*	7.031*	6.8628*	0.030
UEMOA	-	-	-	-	-	
Δlog(M0)	-	-	-	-	-	
Pre-Post	1.05	0.193	0.047	0.153	0.880	-0.8627
Δlog(Money Base)	-	-	-	-	-	
Pre-Post	3.05***	1.73*	17.073***	6.55**	4.9067**	-0.8633
Seg1-Seg2	3.08***	1.58	19.47***	7.346***	5.0305**	-0.5352
Δlog(Reserve Money)	-	-	-	-	-	
Pre-Post	12.06*	5.04***	66.89***	24.25**	23.8856***	-0.2168
Seg1-Seg2	17.02***	4.62***	81.62***	32.24***	30.0182***	0.774
Seg2-Seg3	2.48***	2.32**	9.32***	5.004**	4.5357**	-1.3351

Notes: Columns 2-5 re[resnt tests for difference in variance. Column 6 (t-test) is a test fordifference in means. *,**,*** indicates rejection of the null of no significant differences in the variance (or mean) of the two indicated segments at the 10%, 5% and 1% levels of significance respectively.

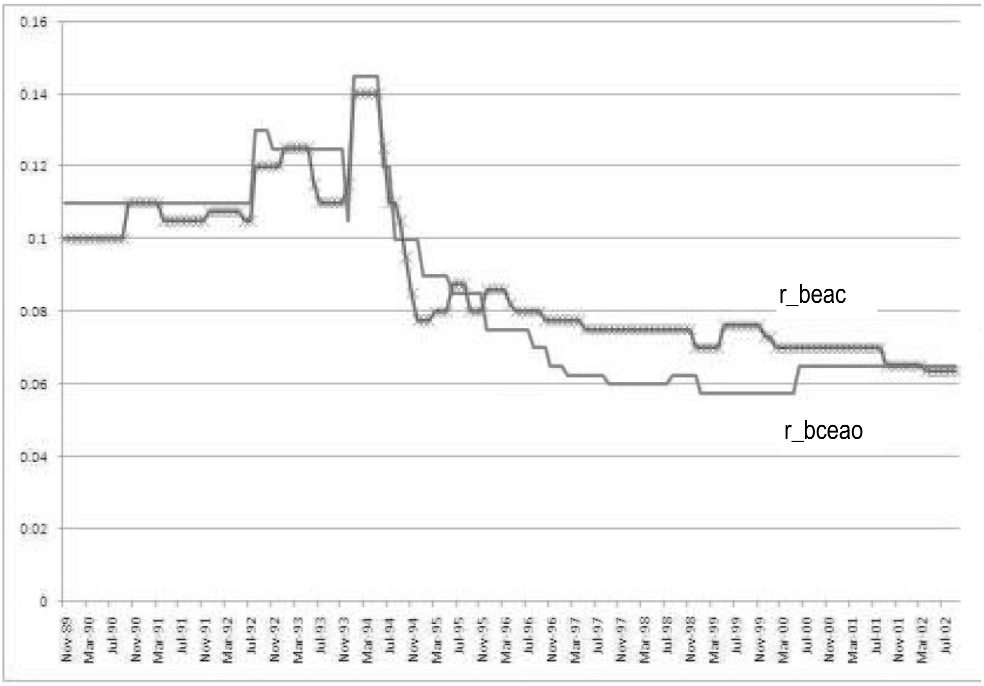
5. Policy implications

Monetary variability and monetary policy

The main objective of monetary policy, price level stability, has not changed over the years. However, increasing internationalisation of financial markets implies that both real and nominal shocks to money stock have broadened the scope of issues that must be considered when pursuing policies geared towards domestic price stabilisation. In addition, it has widened (and complicated, somewhat) the scope of policy transmission channels that may apply.[20]

In the Franc zone, as in any other credible monetary union, financial integration diminishes the ability of policy makers, at the national level, to pursue domestic stabilisation policies independently. The central banks determine interest rates for the countries within their jurisdiction, thereby generating a limited scope for independent monetary policy by any individual country (see Figure 1). While there is some level of commonality in the breaks detected for each given series in member states, it is also readily evident that in some cases we detect breaks that are only particular to individual member states. This result suggests that for some countries the centralised monetary policy may, indeed, be sub-optimal since the possibility of having a tailored response for individual member states is limited.

Figure 1: BCEAO and BEAC Rediscount Rates, 1989:11-2002:09



Policy recommendations from analyses that ignore structural changes can be perilous (Hansen, 2001). However, there is no shortage of empirical articles that analyse monetary variables under the assumption of a break date dictated by some exogenous policy implementation date. The application shown in this paper has highlighted the degree of information loss that a researcher can face by making such a simplifying assumption. For the Franc zone, the 1994 currency devaluation is arguably the most important monetary policy decision in its history, and it is of little surprise that almost all articles on the macroeconomics of the zone make mention of it, in one form or another. It is also true that it is not uncommon for an *a priori* assumption of a single break date in the money stock of the zone to be made using the official currency devaluation date. Specifically, our results have shown that substantial information is lost by making such an assumption. In fact, when there is no provision for the possibility of multiple breaks, any conclusions drawn are likely to be severely biased. Although it may be argued that the imposition of the breakdate averages out the structural breaks that are extracted using data-driven methods, the period being considered then becomes an important influencing factor. In short, the scope for erroneous conclusions about the degree of integration of the monetary series is increased by the implicit suppression of some breakdates.

The important implications of appropriate monetary policy, hence price stability, requires a correct assessment of the order of integration of the real money balances. An inadequate assessment of the money variable will inevitably result in estimation errors, and hence inappropriate policies.[21] The bias induced by the number of breakdates that go undetected through imposing a *single* one *a priori* should be adequate justification for employing data-driven methods of break detection.

Monetary variability and aggregation

An important conclusion drawn from our results is the importance of the appropriate choice of target variable in monetary policy formulation. This is due to the heterogeneity in the number and timings of detected breakdates in the three monetary variables.

In this paper, the Money Base is an aggregation of M0 and Reserve Money. While significant breaks (in the variance) are detected in the Money Base series (Table 6), it is clear from the results reported in Tables 7 - 8 that when one considers only the aggregated series (i.e. Money Base) alone, there is significant loss of information, a result readily observable for each country in the sample. The results, presented in Tables 6 - 8, therefore offer some support for Granger's (1980) aggregation hypothesis. Hence, in the determination of which variables to consider in empirical analysis, the choice of variables that are used in research for policy making should be of primary concern for its pragmatic implementation. Choice of a given variable may imply that some inherent information may not be captured, and may not therefore attract the attention of policymakers, even though it should. For example, the use of either M0 or Reserve Money has uncovered more breakdates than the aggregated Money Base variable, suggesting that the latter variable actually 'masks' the changes of the former ones. However, the specific purpose of the investigation is paramount and should be given more weight in the decision-making process. In particular, when one assesses the aggregated data across the zone (i.e. UEMOA and CEMAC in Tables 22 - 24), the extent of 'missing' information becomes even more obvious. A casual assessment of the literature shows that there is no shortage of studies that aggregate across the Franc zone, and which present policy suggestions based on their estimates. Our estimates reveal some significant loss of information, which is particularly important when one considers for example zone-wide policy impact on individual member states.

6. Conclusions

Application of methods that ignore structural changes can lead to inaccurate inferences being made about economic relationships, hence in misleading policy recommendations. Even when the existence of a certain break is considered an unambiguous fact, it is essential for the researcher to condition analysis, modelling and policy recommendations on the potential existence of multiple breaks of unknown timing. This paper employs a method that could address such an issue, and has shows how misleading inferences can be when based on an imposed (*known*) single breakdate (in this case, an official currency devaluation date) and not on data-detected breakdates. Our findings also highlight the importance of scrutinising for the most appropriate monetary variable for macroecomomic modelling since aggregate variables are likely to mask the true dynamics of their components.

Under the assumption that developing countries are more likely to suffer from misleading policy recommendations regarding monetary variables, we have analysed three important potential monetary policy variables for thirteen Franc zone countries. We propose that break detection and timing methods, such as the one applied in this paper, are vital for correct model specification, improved analyses and policy formulation. Our results also offer some support for Granger's (1980) aggregation hypothesis, as we are able to extract more information on structural breaks from the disaggregated data compared to the aggregated data — irrespective of whether aggregation is done across the monetary variables or across member states. In view of our findings further research is warranted, in that there is a need for a country by country analysis in order to capture the overall effect of zonal monetary policy and draw robust conclusions about the soundness of such decisions.

Accepted for publication: 7 May 2009

Appendix

A. The Franc zone

The CFA Franc zone is the oldest monetary union currently in existence, predating the eurozone by many decades with the 14 member states' currencies pegged to the euro (formerly the French Franc). The CFA Franc zone is made up of two regions. The West-African group is referred to as the *Union Économique et Monétaire Ouest Africaine* (hereafter UEMOA), and uses a common currency *Franc de la Communuaté Financière de l'Afrique* (CFAF) issued by their regional central bank (BCEAO). The Central-African group, often referred to as the *Communauté Économique et Monétaire de l'Afrique Centrale* (hereafter CEMAC), uses a common currency called the *Franc de la Coopération Financière Africaine* (CFAF) issued by their regional central bank (BEAC). (The acronyms BCEAO and BEAC refer to *Banque Central des Etats* *de l'Afrique d'Ouest* and *Banque des Etats de l'Afrique Central* respectively.) Some features of the Zone set it apart from the rest of Africa's sub-region, particularly the fixed parity with the euro (formerly the French Franc), the guaranteed convertibility of the CFA Franc by the French Treasury, the pooled foreign exchange reserves and the limits to credit to governments aimed at curbing government over-spending. Of relevance to this paper is the fact that the monetary and exchange rate policies are set by the two central banks, and not national authorities. Hence, policy decisions should reflect the fact that the collective welfare of the union supersedes the welfare concerns of an individual member state.

B. The currency devaluation of 1994

Arguably, the most important policy issue in the history of the Franc zone has been the one-time currency devaluation in January of 1994. Especially over the mid-1980s through 1993, the economies of the Franc zone showed little economic growth (if any) and goods produced by these countries were largely priced out of the world market as the exchange rate for the CFA franc was artificially high. As a means of rectifying the situation, after consulting with one another and with both the IMF and France, the member states made the bold decision to devalue the CFA Franc (CFAF) by 50 pr cent. Indeed, on the 12th of January 1994 it became official that a 100 CFAF exchanged for 1 French Franc (FF), instead of the previous rate of 50 CFAF: 1 FF. However, there is no final verdict yet as to whether this strategy has offered long-term gains to the economies of the member states.

ENDNOTES

1. Department of Economics, Newcastle University Business School, Newcastle upon Tyne, NE1 4JF. Corresponding author: Simeon Coleman, Division of Economics, Nottingham Business School, Nottingham Trent University, Nottingham NG1 4BU. Email: simeon.coleman@ntu.ac.uk We gratefully acknowledge valuable comments on earlier versions of this paper from colleagues, anonymous referees and editors of this journal for helpful comments. All remaining errors are ours.

2. An idea popularised in the famous Nobel lecture by Friedman (1977).

3. Changes in the political environment, the Terms of Trade, perceptions of non-independence in the judicial system and institutions, the security of investments, and the credibility of policy announcements may well lead to huge capital inflows/flight.

4. See Caporale (1993) and references therein for a review of some studies on both sides of the debate.

5. For economies with such characteristics, manipulating M0, which although not

under the direct control of Central Banks can be influenced through conventional policy instruments, remains a potentially effective monetary policy strategy.

5. Nevertheless, it is relatively straightforward to condition the analysis on observables as well, although beyond the scope of this paper.

7. Reserve Money being a result of policy on Reserve requirements. All three variables are, at least directly or indirectly, available to the Central Banks as policy instruments for each of the countries in our sample.

8. Some early research articles include Dornbusch, 1973; Obstfield, 1986; Hossain, 2005.

9. For the interested reader, Appendices A and B provide a brief background to the CFA Franc zone and the 1994 currency devaluation.

10. A potential limitation of the procedure is that it does not cater explicitly for possible cross country dependency in the variables. Moreover, our use of differenced data may ignore common trends in the data. However, given that we use monthly data in this paper these potential limitations are unlikely to introduce any significant bias, if at all. We thank an anonymous referee for a comment on this.

11. With the large number of HAC estimators available to the researcher, this stage allows for some flexibility.

12. Note that in order to comply with the relevant econometric literature, we have used the terms date and breakdate to refer to the month and break-month that correspond to our sample frequency.

13. Sansó, Aragó, and Carrion, (2003) derive some of the asymptotic properties of I&T, SAC1, and SAC2 for the various levels of kurtosis while Andreou and Ghysels (2002) provide some simulation evidence for I&T and K&L using a number of GARCH(1,1) DGPs. See also Karoglou (2006c).

14. This algorithm has been found to be more robust to the existence of transitional periods, which are particularly relevant to the series of developing economies, when compared to the ICSS algorithm of Inclan and Tiao (1994), since it imposes the detection of breakdates to be ordered in time (and therefore it can avoid possible masking effects due to the presence of transitional periods).

15. Naturally, an even more robust procedure would require testing the statistical equivalence of higher moments as well. However, the focus of this paper is the first two moments only and therefore this assumption is actually weak.

16. All tests have been carried out using *EViews*.

17. This period is particularly significant, as it includes the two main periods likely to introduce significant breaks in the series - the 1994 devaluation and the pegging of the CFAF to the euro in 2001.

18. Although this measure makes the link between M0 and prices in country i less straightforward, the analyses and policy deductions made in this paper are still valid with this measure of M0.

19. See Appendix A for a brief description of the background of the monetary groups and their central banks, often referred to by the acronyms BCEAO and BEAC.

20. A thorough review of the administrative and constitutional arrangements that underpin the entire Franc zone can be found in some previously published literature including Fielding (2002).

21. The well documented events of the Asian crisis of 1998/9, and subsequent effects of contagion, underscore the potential deleterious consequences of inadequate adjustment of monetary policy in such situations.

22. Of course, the implications of this result is by no means restricted to the Franc zones. However, the limitations on country-level monetary policy formulation in the monetary union, and the typical imposition of the breakdate of January 1994 in empirical work, make it particularly relevant.

References

Andreou E and Ghysels E (2002) 'Detecting Multiple Breaks in Financial Market Volatility Dynamics', *Journal of Applied Econometrics*. 17, 579-600.

Barro R J (1976) 'Rational Expectations and the Role of Monetary Policy', *Journal of Monetary Economics*. 2, l-32.

Brown M B and Forsythe A B (1974), 'Robust Tests for the Equality of Variances', *Journal of the American Statistical Association,* 69, 364-367.

Caporale T (1993) 'Monetary Variability and Real Output', *Economics Letters*, 42, 219-222.

Devereux M (1987) 'The Effects of Monetary Variability on Welfare in a Simple Macroeconomic Model', *Journal of Monetary Economics*, 19, 427-435.

Dornbusch R (1973) 'Devaluation, Money, and Nontraded Goods', *American Economic Review*, 63(5), 871-880.

Fielding D (2002) *The Macroeconomics of the Monetary Union, An Analysis of the CFA Franc Zone,* London: Routledge.

Fielding D (2004) 'How Does Monetary Policy Affect the Poor? Evidence From the West African Economic and Monetary Union', *Journal of African Economies,* 13(4), 563-593.

Friedman M (1977) 'Nobel Lecture: Inflation and Unemployment', *Journal of Political Economy,* 85, 451-472.

Granger C W J (1980), 'Long Memory Relationships and the Aggregation of Dynamic Models', *Journal of Econometrics*, 25, 227-238.

Gray J A (1976) 'Wage Indexation: A Macroeconomic Approach', *Journal of Montary Economics*, 2, 221-235.

den Haan W J and Levin A (1997), 'Vector Autoregressive Covariance Matrix Estimation'. Manuscript, University of California, San Diego.

Hansen B E (2001) 'The New Econometrics of Structural Change: Dating Breaks in US Labor Productivity', *Journal of Economic Perspectives*, 4, 117-128.

Hossain A (2005) 'Granger-Causality Between Inflation, Money Growth, Currency Devaluation and Economic Growth in Indonesia, 1951-2002', *International Journal of Applied Econometrics and Quantitative Studies. Euro-American Association of Economic Development*, 2(3), 45-68.

Inclan C and Tiao G C (1994) 'Use of Cumulative Sums of Squares for Retrospective Detection of Changes of Variance' *Journal of the American Statistical Association*, 89, 913-923.

Judge G G, Griffiths W E, Hill R C, Lutkepohl H, and Lee, T C(1985) *The Theory and Practice of Econometrics*, 2e, New York: John Wiley and Sons.

Karoglou M (2006a) 'Breaking down the non-normality of stock-returns', Mimeograph, University of Leicester, UK.

Karoglou M (2006b) 'On the Detection of Structural Changes in Volatility Dynamics with Applications', PhD. Thesis, University of Leicester, Leicester, UK.

Karoglou M (2006c) 'The Size and Power of the CUSUM-type Tests in Detecting Structural Changes in Financial Markets Volatility Dynamics'. Mimeograph, University of Leicester, UK.

Kokoska P and Leipus R (2000) 'Change-point Estimation in ARCH Models', Bernoulli 6.

Lee S, Tokutsu Y and Maekawa K (2003) 'The Residual Cusum Test for the Constancy of Parameters in GARCH (1,1) Models'. Working papers at Hiroshima University.

Levene H (1960) 'Robust Tests for Equality of Variances', in I Olkin *et al* (eds.) *Contributions to Probability and Statistics: Essays in Honor of Harold Hotelling.*Palo Alto, Cal: Stanford U P, 278-292.

Obstfeld M (1986) 'Capital Controls, the Dual Exchange Rate, and Devaluation', *Journal of International Economics*, 20, 1-20.

Perron P (1990) 'Testing for a Unit Root in a Time Series with a Changing Mean', *Journal of Business and Economic Statistics*, 8(2), 153-162.

Sansó A, Aragó V and Carrion J L (2003) 'Testing for Changes in the Unconditional Variance of Financial Time Series'. Department d'Economia Aplicada Working Paper, Universitat de les illes Balears, Spain.

Sheskin D J (1997) *Handbook of Parametric and Nonparametric Statistical Procedures*, Boca Raton, FL: CRC Press.

Siegel S and Tukey J W (1960) 'A Nonparametric Sum of Ranks Procedures for Relative Spread in Unpaired Samples', *Journal of the American Statistical Association.* 55, 429-444.

Sokal R R and Rohlf F J (1995) *Biometry: The Principles and Practice of Statistics in Biological Research*, 3e. New York: W. H. Freeman and Co.