Monetary stability and financial development in Sub-Saharan countries

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Abstract

We analyze the interrelation between monetary stability and financial structure in 20 Sub-Saharan economies. Using a panel data set we estimate the impact of monetary stability and financial development on income per capita. Special interest is given to the conditions of the so-called CFA-countries, that have a fixed exchange rate vis-à-vis the French Franc. Is the impact of the financial system development in these countries bigger than in non-CFA countries? We measure monetary uncertainty using an auxiliary (G)ARCH model of monthly inflation. For financial development we take both the role of M2 as credit to the private sector into account. Our sample covers the years 1970-1997. We estimate growth regressions in three different forms: cross-section, interval, and a pooled model. We do find that inflationary uncertainty is relevant for growth of GDP per capita. Financial development is relevant in the low data-frequency models. The differences between CFA and non-CFA countries become apparent in the interval and pooled models. CFA-countries seem to rely more on credit in the interval model. Moreover, in the years 1985-1993 non-CFA countries seemed to suffer more from inflationary uncertainty.

1 Introduction

With the introduction of the single currency in a large part of Europe the theory of optimum currency areas seems to have attracted its recognition. The participants in the Economic and Monetary Union in Europe not only hope to benefit from the short-run reduction of exchange rate volatility, but also strive for higher levels of economic welfare in the long run. Trade integration and an optimal allocation of resources seem to be the cornerstones of the road to a higher income per head in the future. It is not widely known that similar thoughts have been put forward in Africa more than 50 years ago. Both trade and monetary integration are subjects that attracted attention of almost all African policy makers. Indeed, the expected payoffs of these policies seem to be relatively higher in developing economies. In this paper we address the topic of economic development in its relation to monetary and financial development in 20 African economies in the past three decades. Half of our sample countries is currently a member of one of the two African monetary unions that compose the so-called CFA-zone. Since we have long-run evidence for these countries we are able to answer the question whether an increase in monetary stability really leads to more welfare.

In this paper we relate economic and financial development. Financial development stretches out from the monetary circumstances to the provision of liquidity and credit. These are two lines of the literature. First we discuss the relation between economic growth and inflation, after that we concentrate on the relation between growth and financial structure. Today's conventional wisdom says that, at business-cycle frequencies, inflation and growth may be positively related, while that relationship should be negative for the medium and long-run.[1] The direction of long-run causality normally considered is that running from the distortive effects of high inflation and resulting high variability in relative prices to lower growth. Lower growth could occur either via a lowering of total

[1]Theories a la Tobin and Sidrausky suggest a positive effect from permanently higher inflation on growth coming from the real interest rate effect on wealth allocation. The opposite prediction comes from recent growth models with cash-in-advance requirements for investment, which would imply that inflation would act like a tax on investment and lead to negative growth effects of steady-state inflation, implying also that the loss of output from an inflation crisis will be permanent.

productivity, or through the depressing effect of uncertainty on investment, or through the adverse effect on efficiency of credit allocation. The distortive effects should dominate any business-cycle relationship at high inflation levels and at long enough period lengths. However, at lower inflation levels, the causality of the inflation-growth relationship is not so obvious. Supply shocks, positive or negative, could *simultaneously* move growth and inflation in opposite directions and could mask the more subtle distortive effects of low inflation. The theoretical literature therefore points at the distinction between expected and unexpected inflation.

Up until the mid-1970s there was little empirical evidence for any relationship between inflation and growth and in the economic development context there were even doubts about which way the relationship should go. Fischer (1993) found stronger negative associations between inflation and growth in cross-sectional and time series studies of a larger set of countries and a longer time span (see also Barro, 1995). However, Levine and Zervos (1993) showed convincingly that the cross-section correlation between inflation and growth depends on a few extreme inflation, low-growth countries (in their sample, the influential points were Nicaragua and Uganda).

Next we turn to the second line of the literature relevant to our paper. There is a large literature on the relation between economic performance and financial structure, the latter mostly defined by the ratio of bank and public market finance. A majority of the attention goes to the role of banks and credit supply. There are early advocates of either a positive or a negative influence of financial intermediation. Hamilton (1781) and Bagehot (1873) argued that banks are crucial for economic growth. Schumpeter (1911) suggests even a positive impact of the development of the financial sector on both the level and the growth rate of per capita income. These studies give support to the notion that a more developed financial system leads to a better allocation of resources, better monitoring and less information asymmetries. There are also economists who believe that financial development is just a side product of real development (Robinson, 1952). It might even be so that better resource allocation leads to lower savings, which will slow down economic growth (see King and Levine, 1993b).

This debate is hard to solve and causality is hard to pin down empirically. There is recent evidence on the relation given by King and Levine (1993a, 1993b), Levine and Zervos (1998), Rajan and Zingales (1999), Rousseau and Wachtel (1998) Levine, Loayza and Beck (1999). These studies all point at a positive impact of (the exogenous component of) financial intermediation on per capita growth.

All studies include at least some developed countries (and some of them also include developing countries). There is no serious evidence for developing countries on this issue though. This paper tries to fill at least part of this gap by analyzing Sub-Saharan economies. We have a simple argument to focus on these countries. Fourteen of the countries are members of the CFA Franc zone, some of them more than 50 years. These countries use a common currency, the CFA franc, that is freely convertible into French francs at a fixed rate. It is widely believed that these economies benefited from the exchange rate stability as guaranteed by the CFA-system. Despite serious problems at the end of the 1980's and the beginning of the 1990's the growth rate of the CFA-economies is believed to be above the normal African non-CFA levels. This paper tests whether monetary uncertainty, measured by inflationary uncertainty, and financial structure, measured by monetization (M2) and credit to the private sector, affect CFA-economies differently than non-CFA countries. We do not consider the discussion of financial structure, as defined by the ratio of public versus private supply of capital, to be relevant for Africa since there are no lively stock markets active in the countries and sample period under consideration. Moreover, the recent literature on the relevance of the development of financial systems for economic growth finds strong empirical support in favor of the so-called legal view (see for instance Beck *et al.*, 2000, and Levine, 2000). According to the legal view it is the effectiveness of legal institutions and the enforcement of legal rights that matter to the impact of financial systems on economic growth. This emphasis on the legal environment of financial transactions sets the legal view apart from the long-standing debate about the question which *type* of financial activity is alleged to foster economic growth (see Levine, 1997, for a survey of this debate). So instead of asking whether either bank-based or market-based systems are

stimulating economic growth, adherents of the legal view argue that for growth-enhancing contribution of any kind of financial system, one should focus on the legal aspects of that system. The volume or depth of the market for bank credit or the stock market as such is only of secondary importance. The empirical validity of the legal view has been established for bank credit and economic growth (Levine, 1998) and for financial development in general and economic growth (Levine, 2000).

Our goal is to develop a simple model of per capita growth. We check the relevance of monetary uncertainty and financial structure (and its interaction) for economic development. The next section describes the countries in our sample and discusses the history of the CFA-system (see also Clément *et al*, 1996 and Mehran *et al*, 1998). Next we present our approach to model inflationary uncertainty. We use monthly data to develop unexpected inflation variances per country. Section 4 gives the growth regressions. We perform three different methods to analyze our topic. We employ a cross-section analysis, an analysis using five-year averages, and an analysis based on pooled data. Since the literature is not conclusive on the appropriateness of either method we propose to use them all. We discuss the use of instruments in accounting measurement errors and endogeneity problems. Section 5 concludes.

2 Sub-Saharan Africa and the CFA franc zone

More than any other continent Africa has been experimenting with economic integration. For more than a half-century various groupings of countries emerged and collapsed. At the moment eleven economic blocks are seeking to resolve trade and monetary problems. For the perspective of this paper two monetary blocks are prominent:

- West African Economic and Monetary Union (WAEMU), consisting of Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo[2].
- Central African Economic and Monetary Community (CAEMC), consisting of Cameroon, Chad, Congo, Central African Republic, Equatorial Guinea and Gabon.

[2] Guinea-Bissau joined the WEAMU in 1997.

These blocks form the Communauté Financière Africaine, or the CFA-zone. The franc zone is administered by two central banks, one for each monetary union (see Hallerberg and Özden, 2000). The *Banque Centrale des Etats de l'Afrique de l'Ouest* (BCEAO) serves as the common central bank for the WAEMU, and the *Banque des Etats de l'Afrique Centrale* (BEAC) serves as the common central bank for the CAEMC. Each central bank issues a version of the CFA-franc[3]. The parity of both versions was constant from 1948 until January 1994; 50 CFA-francs to one French franc. On 12 January 1994, after much debate and years of economic hardship, the CFA-franc was devalued; the parity is now 100 CFA-francs to one French franc.

The zone functions under a number of key operating principles:

- A fixed parity against the French franc, adjustable if required by economic reasons after consultation with the French government and unanimous decision of all member countries within each monetary union.
- The CFA-franc is fully convertible into the French franc and, with some exchange restrictions, into other currencies. Convertibility is guaranteed through an agreement with the French government. Under this agreement, each central bank has a so-called operations account with its foreign exchange reserves at the French Treasury and there is an overdraft facility provided at market-related interest rates in case of need.
- There is free movement of capital within the zone, including to and from France.

There are a number of operating rules stipulated in the statutes of the two central banks to preserve these principles (and as a means of encouraging financial discipline). These rules require that each central bank:

- Maintain at least 65 percent of its foreign assets in the operations account with the French treasury.
- Maintain a foreign exchange cover of at least 20 percent of their sight liabilities. If the balance of foreign reserves held at the operations account is less than 20 percent of direct claimable obligations for a period of 3 months end, the African central

[3] Communauté Financière Africaine in the WAEMU and Coopération Financière en Afrique Centrale in the CAEMC.

banks have to take measures to limit the supply of credit. The African countries are obliged to pay the following interest rates if their balance on the operations account is negative:

- Deficit between 0-5 million FF: 1%
- Deficit between 5-10 million FF: 2%
- Deficit bigger than 10 million FF: the average interest on short-term Treasury issues.

In turn pays the French Ministry of Finance interest equal to the average interest on short-term Treasury issues if the operations account shows a surplus above 10 million FF.

- Limits its credit to each government of member countries to a ceiling equivalent to 20 percent of that country's government revenue in the previous year.

The most unique thing about the franc zone is that it is a monetary union with a fixed exchange rate, where the anchor currency country (France) has always guaranteed the convertibility of the CFA-franc into French francs (now Euros). The influence of France is big; French officials participate in the executive boards of the two regional central banks and the country provides extensive financial and technical assistance to the member countries of the CFA-zone.

Recently, the so-called Economic Community of West African States (ECOWAS) declared that they intend to form a monetary union (among the WAEMU-countries plus Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone) in 2004 (see Masson and Pattilo, 2000).[4] The strive for monetary stability and free trade is apparent in a couple of other organizations, like in the recent revived East African Community (EAC), or the Common Market for Eastern and Southern Africa (COMESA). Figure 1 gives an overview of current status of all African countries.

<Insert Figure 1 about here>

[4] Cap Verde is also a member of the ECOWAS-group, but links to the Euro via Portugal.

How do the various blocks perform? In this paper we focus on blocks mainly: the CAEMC, the WAEMU, the non-WAEMU ECOWAS and the COMESA-group. Table 1 gives statistics for those countries for GDP-growth, inflation and an indicator of financial development: credit to the private sector as a percentage of GDP. We give data per country for two periods: 1970-1984 and the more troublesome 1985-1998 period. Moreover, we plot the averages for the groups.

Table 1 reveals that the various blocks do not differ dramatically in GDP-growth rates. But there is a difference between the monetary unions and the other two blocks if one sees the inflation rates and the financial development indicators. Inflation in the non-monetary union countries is typically higher, while financial development is lower on average.

<Insert Table 1 about here>

3 The Uncertainty Measure of Inflation

This study examines the impact of monetary uncertainty and financial structure on per capita economic growth (*PCGROWTH*) for a group of African countries (see Table 2 for a full list of countries). In our main analysis we use annual observations for our growth regression. For the uncertainty measure we need annual information on volatility. In order to be able to model monetary uncertainty we need a higher frequency of data to construct the volatility measure. To that extent we use monthly data on inflation, money growth and relative changes of the nominal exchange rate. We estimate a monthly model and use the variances from that model as a proxy for uncertainty. The empirical analysis refers to the period 1970-1997. As pointed out in the introduction there seems to be split in economic development of the Sub-Saharan countries around 1985. In order to explore this the total sample period is split into two periods (1970-1984 and 1985-1997) for a time series analysis of the data.

For each country and sub-period a measure of monetary uncertainty is needed. The uncertainty measure is derived from information on the volatility of individual countries' monthly inflation. Inflationary uncertainty is known to be the number one representative of monetary uncertainty. We follow the empirical uncertainty literature by deriving an uncertainty proxy from the unpredicted part of a forecasting equation of inflation. The method starts by estimating a forecasting equation to determine the expected part of inflation. We specify the forecasting equation for each country *i* as follows:

$$INF_{i,t} = \beta_{i,1}\, INF_{i,t-1} + \beta_{i,2}\, M_{i,t} + \beta_{i,3} M_{it-1} + \beta_{i,4}\, d(\log(E_{it})) + \varepsilon_{i,t} \qquad (1)$$

where $INF_{i,t}$ represents the percentual rate of change of the Consumer Price Index of country *i* in month *t*, $M_{i,t}$ represents the percentual rate of change of the money stock (M2) of country *i* in month *t* and E_{it} the nominal exchange rate (local currency per dollar). $\varepsilon_{i,t}$ is a residual term which might be nonnormally distributed (see hereafter). All data are from International Financial Statistics of the IMF. The equation is estimated, for all countries individually, using data for the January 1970 up to and including December 1997 period.

The next step is to derive the (monthly) measure of uncertainty by using the residuals from the forecasting equation. Since inflation often displays volatility clustering, especially when inflation is measured at such a high frequency, estimating the forecasting equation by the Ordinary Least Squares (OLS) technique might not be appropriate. Therefore, before deriving the uncertainty measure, we test whether an OLS estimate of the forecasting equation results in ARCH effects by using a Lagrange multiplier (LM) test with five lags. This test suggests considerable ARCH effects for almost all countries in the sample. For that reason, we estimate the forecasting equation by one or another variant of an Autoregressive Conditional Heteroskedastic (ARCH) model of volatility. The ARCH approach comes down to jointly estimating a mean equation for inflation and an additional equation for the conditional variance. For reasons of convenience, the specification of the "forecasting" equation is the same for all countries (see Equation (1)).

The precise method we follow is as follows. We start by estimating the OLS-version and test for ARCH (using 3 lags, so one quarter). If there are ARCH-effects we proceed and estimate an ARCH-specification and test for ARCH-effects again. If necessary we include either higher-order ARCH or even GARCH. If the residual-test passes the hypothesis of absence of ARCH-effects we use the final specification. Table 2 shows which technique is used for the different countries in the two sub-samples. The table also shows the F-values for remaining ARCH effects, based on the ARCH LM(3) test.

<Insert Table 2 about here>

We proxy the monthly inflationary uncertainty by the square root of the monthly conditional variance. The final step is to derive an annual uncertainty proxy for the yearly data (*UNCER*). This is simply done by taking the average monthly (conditional) standard deviation over the sub-period. Table 2 presents the results.

<Insert Table 3 about here>

4 Estimation results

In the previous section we discussed our approach to estimate unexpected inflation. We constructed annual variances of the inflation forecasting equations. Next we use these estimates in a model that explains economic growth. The intuition runs as follows. Unexpected inflation is believed to be harmful to economic growth. Inflation variability correlates with the level of inflation (see Barro, 1995). The higher the level of inflation the more variable the price level will be. Especially investment is expected to suffer from uncertainty, although economic theory is not conclusive on this topic. For instance in the case of perfect markets, risk neutral investors, reversible investment decisions it can be shown that investment reacts positively to a higher uncertainty of e.g. sales prices. Most of the empirical studies do find a negative sign of the investment-uncertainty relation though (see Lensink *et al*, 2001). Countries that have been able to reduce inflationary uncertainty

We follow the literature and explain the development of income per head (see Barro and Sala-i-Martin, 1995). There are three approaches found in the literature:

- Cross-section growth regressions. In these models the average growth over the sample period is the focal variable in the analysis. The main argument to use a cross-section model is the notion that cross-country variance is more important than time variance. Indeed, some determinants of income per capita are rather constant through time. Think for instance of enrolment data and other fixed determinants like geographical, legal, and societal data.
- Fixed-interval averages. In this class the entire sample is averaged in mostly five-year sub-periods (see Islam, 1995). This avoids serious measurement and stationarity problems. Moreover, this fixed-interval average method appeals to the nature of some data that have a confident measurement twice in a decade.
- Panel regressions. In these models the mixture of both time and country variance is exploited. The main advantage of this model type is the more appropriate treatment of dynamics. It requires explanatory variables that indeed show variation over time. The main disadvantage of this model type is that in some cases it is hard to treat time variation in an appropriate way. It is likely that not all the variables have the same time series properties across countries. Moreover, if a lagged dependent variable is included in the model, instruments (or Generalized Methods of Moments) should be used to correct for endogeneity of the regressors. The selection of instruments is in most cases at least troublesome.

All the models and methods have arbitrary elements. The selection of countries, variables, and years determines the outcomes to a large extent. Sala-I-Martin (1997) proposed a robust method to correct for the selection of variables bias. In this so-called extreme bound analysis random combinations of determinants are used and the final estimates are based on average outcomes.

Since our study explores the issue of monetary stability and financial development in 20 African economies we propose to proceed along the lines of the three methods referred to above.

4.1 Cross-section model

The first approach is the cross-section model, or simply the growth regression. This model reads in its basic form as follows:

$$\text{Log}(Y(T)/P(T))\text{-Log}(Y(base)/P(base)) = a_1 \text{ Log}(Y(base)/P(base)) + a_2 X + a_3 Z + e$$

Where Y represents real GDP, P population, X a set of "normal" determinants of economic growth, such as investment per GDP, government expenditure (possibly in various categories), enrolment as a proxy of human capital, and Z a set of additional determinants, for which a wide range of options exists. The parameter a_1 is of interest if one studies convergence of growth. In our case we are not as such interested in convergence.

We construct averages of the data available over the years 1970-1997 and use the averages in the regressions.
We experimented with the following groups of variables:

- Base variables: Investment as a percentage of GDP, government consumption as a percentage of GDP, trade as a percentage of GDP en gross primary enrolment;
- Geographical data: latitude, longitude, area of countries, and a dummy variable for oil exporter or the country to be locked in by land;
- Legal data: a dummy variable that indicates British of French legal origin;
- Financial data: M2 as a percentage of GDP, Credit to the Private Sector (CPS) as a percentage of GDP, inflation and our constructed inflationary uncertainty, and the Black Market Premium. Moreover we constructed a dummy variable indicating whether a country is a member of either the Western or Central African Economic And Monetary Union.

For the first group we find that only investment contributes significantly in any equation. From the second group only longitude enters the equation in some cases, but not in a robust way. The legal systems do not have a significant impact on the endogenous

variable. Before entering the class of financial variables our base model consists of the base-year GDP per capita and investment only. Since we have a limited number of countries (19, since Ethiopia lacks data for GDP per capita in 1970), we decide to proceed with this elementary base model.

The financial variables are correlated. So is inflation heavily correlated with its uncertainty (partial correlation coefficient of 0.999). This finding is consistent with the literature, where it is shown that inflationary uncertainty is positively correlated with the level of inflation. M2 and credit to the private sector (CPS) are also correlated (0.618). So we decide to include inflationary uncertainty and one of M2 or CPS. Table 5 contains the results. Table 4 shows that inflationary uncertainty (or inflation itself) has a negative impact on the growth rate of GDP per capita. The size of the monetary sector, as measured by M2 has a clear positive impact on growth. Credit to the private sector is less convincing. We also checked the interaction between inflationary uncertainty and M2 and CPS, but did not find significant effects. The same holds for the Black Market Premium. Finally we included a dummy variable for the countries that are a member of one of the monetary unions, but did not find significant results.

<Insert Table 4 about here>

4.2 Fixed intervals

Next we estimate the model in intervals. We take averages over 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1997. For these six periods we estimate the model with least squares (we ignore the requirement to estimate the model with instruments in this version of the paper). Table 5 gives the results.

<Insert Table 5 about here>

Table 5 reveals that the cross section results also hold in the interval model. Investment still is an important determinant. We also tested for the relevance of trade, government

consumption, and primary enrolment but none of these variables had additional explanatory power. As Table 5 shows the impact of inflationary uncertainty is now less convincing. The role of M2 and CPS change as compared with the cross section analysis. In the cross section model M2 dominated CPS, but in this interval model CPS is more important. We also checked for the interaction between inflationary uncertainty and CPS, but did not find significant results. Also the black market premium did not add any additional information.

Next we estimate he same models for the countries that belong to the CFA-zone. Table 6 gives the results. The results show that inflationary uncertainty is no longer important in these countries. M2 is also unimportant, but the credit to the private sector is important.

<Insert Table 6 about here>

In order to assess the results we estimate the same models for the countries that are not a member of one of the Economic and Monetary Unions. Table 7 gives the results. This table shows that inflationary uncertainty is a bit more harmful to the non-monetary union countries. Moreover in these economies M2 is of more importance than credit to the private sector.

<Insert Table 7 around here>

4.3 **Pooled estimation**

The third approach, pooled estimation, exploits both time and country variation of the data. We first estimated the model that we have shown in two previous subsections. Table 8 gives the results. First we only include investment, next we include the variance of unexpected inflation and the two financial quantity variables, M2 and CPS. As Table 8 shows the variance of unexpected inflation does not contribute significantly in explaining

the variance of the growth rate of GDP per capita. Similar arguments hold for money and credit.

<Insert Table 8 about here>

Experimenting with the model shows that government consumption enters the model (with a negative sign). So we proceed by including both investment and government consumption as a percentage of GDP in the equations to be estimated.

We estimate the same model for the countries that are a member of a monetary union and the countries that don't belong to one of the unions. Tables 9 and 10 present the results. In general we find that the financial quantity variables, money or credit, are insignificant in both sub-samples. Inflationary variability matters in the monetary union estimation, while in the non-monetary union group inflationary uncertainty is not significant. This result seems surprising. Inspection of the data shows that for some non-monetary union countries, like Zaire, there are periods with excessive monetary uncertainty. These excessive periods disturb the assumption of a common inflationary uncertainty parameter across the whole sample.

<Insert Tables 9 and 10 about here>

The pooled model also allows us to analyze the economies in sub-periods. As known the troublesome years of the CFA-countries are from 1985 up to the devaluation in January 1994. It is interesting to estimate our model using over this sub-period and the years before. So we estimate the model with all the variables included (with CPS) for both 1971-1984 and 1985-1993 for the CFA and the Non-CFA groups. Table 11 gives the results. Table 11 shows that investment was more important in the period 1970-1984 than in the years 1985-1993. Government consumption had a significant negative impact on economic growth in the CFA-countries, but not outside the CFA-group. Inflationary uncertainty has no impact before 1984, but for 1985-1993 there is a remarkable difference between the two groups. One can see that the CFA-economies were not

hindered by monetary uncertainty (on the contrary), but non-CFA economies were. The role of credit is rather unimportant in all cases.

<Insert Table 11 about here>

5 Summary and conclusions

In this paper we analyze the impact of inflationary uncertainty and financial development on per capita growth of GDP in 20 African economies. We distinguish two groups of countries: countries that are a member of the CFA-zone (over two currency unions) and non-CFA countries. Moreover we analyze two sub-periods: 1970-1984 and thereafter. Our main focus is on inflationary uncertainty and financial development. Is a reduction of inflationary uncertainty through monetary unification beneficial to economic growth?

Our main findings are as follows. First, we find that the investment to GDP ratio is the single overall significant explanatory variable in any growth equation we estimated. Second, it depends on the modelling method which of the other variables are found to be relevant. We analyzed three types of models, cross section, interval, and pooled models. The cross section model indicates that money (M2) is relevant for economic growth. However if we consider time variation to be important, the role of M2 diminishes in an interval model and even vanishes in a pooled model. For credit to the private sector a similar story holds. Credit to the private sector is important in the interval model, but vanishes if the frequency of the data increases.

Inflationary uncertainty is proxied by subinterval estimation over 1970-1984 and 1985-1997. We take into account that volatility might be clustered. The resulting variance of inflationary uncertainty is important in the cross-section and interval model. If we increase the frequency of the data this robustness vanishes. In the pooled model we show that there is a rather different role for inflationary uncertainty across the CFA and non-CFA economies in the troublesome period 1985-1993. It seems that despite a lower growth rate CFA countries did enjoy monetary stability.

We find no evidence for an impressive role of financial development in explaining real growth. But a similar argument holds for enrolment, trade shares, short-term debt, black market premia and more variables that are normally found to be relevant in empirical growth equations. It is therefore more interesting to explore the role of expected and unexpected inflation further in the quest for the explanation of African growth.

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Table 1 – Economic indicators

	GDP		Inflation		Credit	
	1970-1984	1985-1998	1970-1984	1985-1998	1970-1984	1985-1998
CAEMU						
Cameroon	7.32	0.20	10.96	6.35	22.62	17.41
Chad	0.52	4.25	20.25	5.08	10.92	8.04
Central African Republic	1.54	1.10	7.60	3.06	14.22	5.98
Congo, Rep.	8.43	0.56	9.30	8.11	17.54	14.83
Equatorial Guinea		12.97				14.71
Gabon	7.75	2.27	10.99	3.70	17.60	14.30
Average	**5.11**	**3.56**	**11.82**	**5.26**	**16.58**	**12.55**
WAEMU						
Benin	3.03	3.50		11.26	20.04	16.83
Burkina Faso	3.06	3.96	4.85	3.70	12.69	12.96
Cote d'Ivoire	4.15	2.65	10.54	6.09	35.46	29.39
Guinea-Bissau	2.93	1.49		47.07		12.74
Mali	3.19	2.67		4.29	20.19	13.23
Niger	0.00	2.85	10.28	2.15	12.08	10.57
Senegal	2.62	3.08	10.22	4.10	31.16	24.45
Togo	2.66	2.40	9.61	5.19	20.61	22.42
Average	**2.70**	**2.83**	**9.10**	**10.48**	**21.75**	**17.83**
ECOWAS						
Cape Verde	8.86	4.66	11.25	6.33		22.82
Gambia, The	4.86	3.00	10.17	12.06	18.86	12.05
Ghana	0.57	4.56	49.32	28.21	4.97	5.09
Guinea		4.20				4.24
Liberia					10.09	7.74
Nigeria	3.38	4.21	17.20	30.66	10.17	10.79
Sierra Leone	2.37	-2.44	20.44	61.17	6.20	2.91
Average	**4.01**	**3.03**	**21.68**	**27.69**	**10.06**	**9.38**
COMESA						
Angola	0.95	1.98		2189.43		4.16
Congo, Dem. Rep.	0.92	-2.76	43.33	2601.79	3.23	1.62
Eritrea		4.64				
Ethiopia	2.17	2.73	8.56	6.58	8.50	11.63
Kenya	5.70	3.47	11.80	15.48	24.15	32.17
Malawi	4.62	3.53	13.79	25.82	13.85	8.68
Mauritius	5.20	6.11	12.70	7.13	21.81	38.81
Seychelles	5.62	4.62	13.16	1.52	19.16	12.96
Sudan	3.45	4.60	19.59	72.14	11.14	5.38
Uganda	2.70	5.49	56.20	66.31	6.01	4.06
Zambia	1.36	1.22		82.79	17.59	8.43
Zimbabwe	4.70	3.50	9.68	20.20	24.07	25.92
Average	**3.40**	**3.26**	**20.98**	**462.65**	**14.95**	**13.98**

Notes for Table 1

Source of the data is the CD-ROM World Development Indicators 2000 of the Worldbank, Washington DC. GDP represents the annual growth rates of real GDP, inflation is the annual relative change of the Consumer Price Index, and Credit represents Credit to the Private Sector as a percentage of GDP. All data are averages over the periods mentioned.

CAEMU: Central African Economic and Monetary Union;
WAEMU: Western African Economic and Monetary Union;
ECOWAS: Economic Community of West African States;
COMESA: Common Market for Eastern and Southern Africa.

Table 2 – Volatility models

	1970-1984 OLS-*F*	Method	*F*-value	1985-1997 OLS-*F*	Method	*F*-value
CAEMC						
Cameroon	1.44			0.16		
Chad				4.63	GARCH(1,1)	0.27
Central African Republic				1.64		
Congo	12.03	GARCH(2,1)	1.81	9.82	GARCH(2,1)	0.75
Gabon	2.59	GARCH(1,1)	0.17	8.37	GARCH(1,1)	1.74
WAEMU						
Burkina Faso				2.86	GARCH(1,4)	1.74
Cote d'Ivoire	0.22			2.29	GARCH(1,1)	1.02
Niger	5.02	GARCH(1,2)	0.63	10.04	GARCH(1,1)	0.89
Senegal	10.88	GARCH(1,3)	0.37	0.87		
Togo	1.35			2.27	GARCH(1,1)	1.61
ECOWAS						
Gambia	0.48			10.12	ARCH(1)	0.74
Ghana	16.21	GARCH(1,1)	0.58	15.68	GARCH(1,1)	0.75
Nigeria	1.87	GARCH(1,1)	0.56	1.19		
Sierra Leone				66.52	GARCH(3,3)	0.46
OTHER						
Ethiopia	0.53			3.21	GARCH(1,1)	0.83
Kenya	0.32			4.83	GARCH(3,1)	0.35
Mauritania				1.51		
Mauritius	1.41	GARCH(1,1)	0.38	5.56	GARCH(3,3)	0.86
Sudan	13.44	GARCH(1,1)	0.13	0.77		
Zaire	25.4	GARCH(1,1)	0.06	9.59	ARCH(2)	1.79

Notes for Table 2

The source of the data used is *International Financial Statistics* of the *International Monetary Fund* (CD ROM August 2000). Monthly data are used for Inflation, Money growth and the Nominal Exchange rate (vis-à-vis the U.S. dollar). The model estimated is:

$$INF_{i,t} = \beta_{i,1}\, INF_{i,t-1} + \beta_{i,2}\, M_{i,t} + \beta_{i,3} M_{it-1} + \beta_{i,4}\, d(\log(E_{it})) + \varepsilon_{i,t}$$

where $INF_{i,t}$ represents the percentual rate of change of the Consumer Price Index of country *i* in month *t*, $M_{i,t}$ represents the percentual rate of change of the money stock (M2) of country *i* in month *t* and E_{it} the nominal exchange rate (local currency per dollar). $\varepsilon_{i,t}$ is a residual term.

OLS-*F* = *F*-value of the LM(3) test for ARCH-effects;
F-value: *F*-value of the LM(3) test for ARCH-effects of the ARCH(x) or GARCH(y,z)-model.

CAEMU: Central African Economic and Monetary Union;
WAEMU: Western African Economic and Monetary Union;
ECOWAS: Economic Community of West African States.

Table 3 – Inflationary uncertainty indicators

	1970-1984	1985-1997
CAEMC		
Cameroon	2.07	2.67
Chad		4.22
Central African Republic	2.89	2.71
Congo	2.54	4.54
Gabon	2.41	2.43
Average	2.48	3.31
WAEMU		
Burkina Faso		2.66
Cote d'Ivoire	3.52	1.48
Niger	4.63	2.80
Senegal	3.17	3.78
Togo	3.38	2.40
Average	3.68	2.62
ECOWAS		
Gambia	2.45	2.77
Ghana	9.04	1.84
Nigeria	3.17	3.78
Sierra Leone		9.82
Average	4.89	4.55
OTHER		
Ethiopia	3.16	3.51
Kenya	1.58	2.48
Mauritania		2.76
Mauritius	2.27	1.16
Sudan	5.31	11.76
Zaire	12.06	2127.98
Average	4.88	358.28

Notes for Table 3

Data represent the averages of annual standard deviations of the monthly residuals from the OLS/ARCH/GARCH estimated models of inflation:

$$INF_{i,t} = \beta_{i,1}\, INF_{i,t-1} + \beta_{i,2}\, M_{i,t} + \beta_{i,3} M_{it-1} + \beta_{i,4}\, d(\log(E_{it})) + \varepsilon_{i,t}$$

where $INF_{i,t}$ represents the percentual rate of change of the Consumer Price Index of country *i* in month *t*, $M_{i,t}$ represents the percentual rate of change of the money stock (*M2*) of country *i* in month *t* and E_{it} the nominal exchange rate (local currency per dollar). $\varepsilon_{i,t}$ is a residual term. See Table 2 which model applies for what country.

CAEMU: Central African Economic and Monetary Union;
WAEMU: Western African Economic and Monetary Union;
ECOWAS: Economic Community of West African States.

Table 4 - Cross-section regression results

The model estimated reads:

$$\text{Log}(Y(T)/P(T))\text{-Log}(Y(base)/P(base)) = a_1 \text{ Log}(Y(base)/P(base)) + a_2 X + a_3 Z + e$$

where Y represents real GDP, P population, INV investment per GDP, and Z a set of additional determinants: Variance of unexpected inflation (Var(INF)), Money per GDP ($M2$), and Credit to the Private Sector as a percentage of GDP (CPS). e is a residual. Base = 1970.

log(Y(base)/P(base))	-0.173	-0.142	-0.216	-0.163
	(0.04)	(0.03)	(0.038)	(0.036)
INV	0.056	0.048	0.042	0.044
	(0.013)	(0.011)	(0.006)	(0.008)
Var(INF)		-0.886	-0.629	-0.741
		(0.083)	(0.108)	(0.135)
M2			0.027	
			(0.009)	
CPS				0.012
				(0.01)
R^2	0.437	0.574	0.775	0.585
SSR	2.395	1.707	0.846	1.558

White-heteroskedasticity corrected standard errors are between parentheses. Number of countries is 19 (Ethiopia lacks data for the base year). R^2 represents the adjusted determination coefficient. *SSR* is the sum of squared residuals.

Table 5 - Fixed intervals: all countries

The model estimated reads:

$$\text{Log}(Y(T)/P(T))-\text{Log}(Y((-1))/P(-1)) = a_1 \text{Log}(Y(-1)/P(-1))) + a_2\, INV + a_3\, Z + e$$

where Y represents real GDP, P population, INV investment per GDP, and Z a set of additional determinants: Variance of unexpected inflation (Var(INF)), Money per GDP ($M2$), and Credit to the Private Sector as a percentage of GDP (CPS). e is a residual.

log(Y(-1)/P((-1))	-0.364	-0.378	-0.419	-0.473
	(0.039)	(0.042)	(0.055)	(0.033)
INV	0.01	0.01	0.011	0.044
	(0.001)	(0.001)	(0.001)	(0.001)
Var(INF)		-0.014	-0.013	-0.014
		(0.009)	(0.009)	(0.01)
M2			0.004	
			(0.001)	
CPS				0.005
				(0.001)
R^2	0.809	0.808	0.762	0.898
SSR	0.737	0.588	0.57	0.536

The intervals are 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1997. Data are averaged over the intervals. The estimation method is weighted LS with Fixed Effects estimates. The sample consists of 20 countries over 5 difference periods. Total number of observations is 87. White-heteroskedasticity corrected standard errors are between parentheses. R^2 represents the adjusted determination coefficient. *SSR* is the sum of squared residuals.

Table 6 – Fixed intervals: monetary union countries

The model estimated reads:

$$\text{Log}(Y(T)/P(T))-\text{Log}(Y((-1))/P(-1)) = a_1 \text{Log}(Y(-1)/P(-1))) + a_2\, INV + a_3\, Z + e$$

where Y represents real GDP, P population, INV investment per GDP, and Z a set of additional determinants: Variance of unexpected inflation (Var(INF)), Money per GDP ($M2$), and Credit to the Private Sector as a percentage of GDP (CPS). e is a residual.

log(Y(-1)/P(-1))	-0.466	-0.518	-0.529	-0.563
	(0.083)	(0.042)	(0.107)	(0.084)
INV	0.011	0.011	0.011	0.011
	(0.002)	(0.001)	(0.002)	(0.002)
Var(INF)		-0.001	-0.001	0
		(0.001)	(0.002)	(0.001)
M2			0.002	
			(0.004)	
CPS				0.004
				(0.001)
R^2	0.598	0.605	0.563	0.716
SSR	0.34	0.201	0.281	0.243

The intervals are 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1997. Data are averaged over the intervals. The estimation method is weighted LS with Fixed Effects estimates. The sample consists of 10 countries (Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Gabon, Niger, Senegal, and Togo) over 5 difference periods. Total number of observations is 45. White-heteroskedasticity corrected standard errors are between parentheses. R^2 represents the adjusted determination coefficient. *SSR* is the sum of squared residuals.

Table 7 – Fixed intervals: non monetary union countries

The model estimated reads:

$$\text{Log}(Y(T)/P(T))-\text{Log}(Y((-1))/P(-1)) = a_1 \text{Log}(Y(-1)/P(-1))) + a_2\, INV + a_3\, Z + e$$

where Y represents real GDP, P population, INV investment per GDP, and Z a set of additional determinants: Variance of unexpected inflation (Var(INF)), Money per GDP ($M2$), and Credit to the Private Sector as a percentage of GDP (CPS). e is a residual.

log(Y(-1)/P(-1))	-0.237	-0.236	-0.268	-0.313
	(0.058)	(0.059)	(0.052)	(0.08)
INV	0.012	0.012	0.013	0.013
	(0.002)	(0.002)	(0.002)	(0.002)
Var(INF)		-0.012	-0.012	-0.012
		(0.006)	(0.007)	(0.007)
M2			0.002	
			(0.001)	
CPS				0.003
				(0.002)
R^2	0.845	0.861	0.907	0.851
SSR	0.303	0.223	0.227	0.215

The intervals are 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1997. Data are averaged over the intervals. The estimation method is weighted LS with Fixed Effects estimates. The sample consists of 10 countries (Ethiopia, Gambia, Ghana, Kenya, Mauritania, Mauritius, Nigeria, Sierra Leone, Sudan and Zaire) over 5 difference periods. Total number of observations is 42. White-heteroskedasticity corrected standard errors are between parentheses. R^2 represents the adjusted determination coefficient. *SSR* is the sum of squared residuals.

Table 8 – Pooled estimation: all countries

The model estimated reads:

$$\text{Log}(Y(T)/P(T))-\text{Log}(Y((-1))/P(-1)) = a_1 \text{Log}(Y(-1)/P(-1))) + a_2\, INV + a_3\, Z + e$$

where *Y* represents real GDP, *P* population, *INV* investment per GDP, and Z a set of additional determinants: Variance of unexpected inflation (Var(*INF*)), Money per GDP (*M2*), and Credit to the Private Sector as a percentage of GDP (*CPS*). *e* is a residual.

log(Y(-1)/P(-1))	-0.109	-0.123	-0.135	-0.132
	(0.015)	(0.016)	(0.018)	(0.019)
INV/100	0.313	0.339	0.342	0.344
	(0.041)	(0.044)	(0.045)	(0.044)
Var(INF)*E-09		-0.241	-0.286	-0.280
		(0.175)	(0.186)	(0.169)
M2			-0.008	
			(0.052)	
CPS				-0.018
				(0.045)
R^2	0.196	0.207	0.209	0.212
SSR	1.575	1.478	1.448	1.452

The sample is 1970-1997. The estimation method is weighted LS with Fixed Effects estimates. The sample consists of all 20 countries. Total number of observations is 444. White-heteroskedasticity corrected standard errors are between parentheses. R^2 represents the adjusted determination coefficient. *SSR* is the sum of squared residuals.

Table 9 – Pooled estimation: monetary union countries

The model estimated reads:

$$\text{Log}(Y(T)/P(T))-\text{Log}(Y((-1))/P(-1)) = a_1 \text{Log}(Y(-1)/P(-1))) + a_2\, INV + a_3\, Z + e$$

where *Y* represents real GDP, *P* population, *INV* investment per GDP, *GCO* is government consumption as a percentage of GDP, and *Z* a set of additional determinants: Variance of unexpected inflation (Var(*INF*)), Money per GDP (*M2*), and Credit to the Private Sector as a percentage of GDP (*CPS*). *e* is a residual.

log(Y(-1)/P(-1))	-0.152	-0.174	-0.172	-0.177
	(0.024)	(0.025)	(0.025)	(0.027)
INV/100	0.390	0.431	0.415	0.429
	(0.053)	(0.058)	(0.057)	(0.058)
GCO/100	-0.363	-0.586	-0.528	-0.608
	(0.122)	(0.147)	(0.151)	(0.162)
Var(INF)E-03		-0.514	-0.547	-0.501
		(0.241)	(0.252)	(0.245)
M2/100			-0.141	
			(0.095)	
CPS/100				0.022
				(0.066)
R^2	0.253	0.300	0.303	0.297
SSR	0.835	0.768	0.753	0.768

The sample is 1970-1997. The estimation method is weighted LS with Fixed Effects estimates. The sample consists of all 10 countries (Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Gabon, Niger, Senegal, and Togo). Total number of observations is 230. White-heteroskedasticity corrected standard errors are between parentheses. R^2 represents the adjusted determination coefficient. *SSR* is the sum of squared residuals.

Table 10 – Pooled estimation: non monetary union countries

The model estimated reads:

$$\text{Log}(Y(T)/P(T))-\text{Log}(Y((-1))/P(-1)) = a_1 \text{Log}(Y(-1)/P(-1))) + a_2\, INV + a_3\, Z + e$$

where Y represents real GDP, P population, INV investment per GDP, GCO is government consumption as a percentage of GDP, and Z a set of additional determinants: Variance of unexpected inflation (Var(INF)), Money per GDP ($M2$), and Credit to the Private Sector as a percentage of GDP (CPS). e is a residual.

log(Y(-1)/P(-1))	-0.053	-0.063	-0.082	-0.094
	(0.018)	(0.019)	(0.025)	(0.026)
INV/100	0.305	0.385	0.393	0.401
	(0.071)	(0.077)	(0.078)	(0.078)
GCO/100	0.001	-0.037	-0.045	-0.077
	(0.004)	(0.059)	(0.060)	(0.067)
Var(INF)E-09		-0.014	-0.019	-0.021
		(0.014)	(0.014)	(0.015)
M2/100			0.022	
			(0.061)	
CPS/100				0.090
				(0.080)
R^2	0.216	0.241	0.238	0.245
SSR	0.580	0.528	0.519	0.514

The sample is 1970-1997. The estimation method is weighted LS with Fixed Effects estimates. The sample consists of all 10 countries (Ethiopia, Gambia, Ghana, Kenya, Mauritania, Mauritius, Nigeria, Sierra Leone, Sudan and Zaire). Total number of observations is 230. White-heteroskedasticity corrected standard errors are between parentheses. R^2 represents the adjusted determination coefficient. *SSR* is the sum of squared residuals.

Table 11 – Pooled estimation: sub-periods

The model estimated reads:

$$\text{Log}(Y(T)/P(T))-\text{Log}(Y((-1))/P(-1)) = a_1 \text{Log}(Y(-1)/P(-1))) + a_2\, INV + a_3\, Z + e$$

where Y represents real GDP, P population, INV investment per GDP, GCO is government consumption as a percentage of GDP, and Z a set of additional determinants: Variance of unexpected inflation (Var(INF)), Money per GDP ($M2$), and Credit to the Private Sector as a percentage of GDP (CPS). e is a residual.

	1971-1984		1985-1993	
	MU	Non-MU	MU	Non-MU
log(Y(-1)/P(-1))	-0.257	-0.216	-0.217	-0.128
	(0.052)	(0.051)	(0.069)	(0.056)
INV/100	0.548	0.535	0.399	0.225
	(0.095)	(0.138)	(0.120)	(0.119)
Var(INF)*E-09	-0.267	-0.007	4.275	-0.615
	(0.584)	(0.018)	(1.182)	(0.311)
CPS/100	-0.012	-0.347	-0.019	0.003
	(0.129)	(0.181)	(0.124)	(0.115)
GCO/100	-1.196	0.187	-0.990	-0.154
	(0.359)	(0.175)	(0.212)	(0.189)
Countries	8	8	10	10
N	102	95	89	81
R^2	0.389	0.358	0.422	0.583
SSR	0.398	0.243	0.159	0.113

The estimation method is weighted LS with Fixed Effects estimates. The sample consists of the CFA (MU) and non-CFA-countries (see Tables 9 and 10 for the country names). White-heteroskedasticity corrected standard errors are between parentheses. N is the number of observations. R^2 represents the adjusted determination coefficient. *SSR* is the sum of squared residuals.