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NONPERFORMING LOANS IN SUB-SAHARAN AFRICA: CAUSAL ANALYSIS AND MACROECONOMIC IMPLICATIONS

By

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Abstract: This paper investigates the leading causes of nonperforming loans during the economic and banking crises that affected a large number of countries in Sub-Saharan Africa in the 1990s. Empirical analysis shows a dramatic increase in these loans and extremely high credit risk, with significant differences between the CFA and non-CFA countries, and substantially higher financial costs for the latter sub-panel of countries. The results also highlight a strong causality between these loans and, economic growth, real exchange rate appreciation, the real interest rate, net interest margins and interbank loans, consistent with the causality and econometric analysis, which reveal the significance of macro and microeconomic factors. Indeed, the dramatic increase in these loans is largely driven by macroeconomic volatility and reflects the vulnerability of undiversified African economies, which remain heavily exposed to external shocks. Simulated results show that macroeconomic stability and economic growth are associated with a declining level of nonperforming loans; whereas adverse macroeconomic shocks coupled with higher cost of capital and lower interest margins are associated with a rising scope of nonperforming loans. These results are supported by long-term estimates of nonperforming loans derived from pseudo panel-based prediction models.

JEL Classification Numbers: C33, E44, G21

Keywords: CFA, interbank loans, moral hazard, non-CFA, nonperforming loans, impaired loans, pseudo panel-based prediction models.

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I. INTRODUCTION

Historically, the occurrence of banking crises has often been associated with a massive accumulation of nonperforming loans which can account for a sizable share of total assets of insolvent banks and financial institutions, especially during episodes of systemic crises.[2] More recently, the apparent association between nonperforming loans and banking crises was further corroborated by the 1997 East Asian financial and banking crisis which left the four countries severely affected, with a more than threefold increase in their volume of nonperforming loans in the period leading up to the crisis. For instance, in Indonesia where over 60 banks collapsed during the crisis, nonperforming loans represented about 75% of total loan portfolios [Caprio and Klingebiel (2002)].[3] The banking crisis which affected a large number of Sub-Saharan African countries in the 1990s was also accompanied by a rapid accumulation of nonperforming loans.[4]

In spite of this apparent association between banking crises and nonperforming loans, the literature on banking crises has focused on the macroeconomic determinants of banking crises and less on the various sources of nonperforming loans, which are used as indicator variables to measure the intensity of the crisis, and may be viewed as one possible consequence of the crisis, rather than a critical factor leading to it.[5] This paper focuses on nonperforming loans in Sub-Saharan Africa. These loans are believed to have fueled the banking crisis which affected numerous banks and financial institutions in the sub-panels of CFA and non-CFA countries in the 1990s, causing a large number of banks, particularly the most affected, to be declared bankrupt, and others to undergo major financial and operational restructuring.

Nonperforming loans generally refer to loans which for a relatively long period of time do not generate income; that is the principal and/or interest on these loans has been left unpaid for at least 90 days [Caprio and Klingebiel (1999)]. In the context of the Central Bank of West African States, *Banque Centrale des Etats de l'Afrique de l'Ouest* (BCEAO), the lead time from the status of standard to substandard loans (including doubtful and loss loans) is

[2] Systemic banking crisis refers to a situation where problems banks account for at least 20 percent of total deposits of banks and financial institutions. Since the late 1970s, 114 episodes of systemic banking crises have occurred in 91 countries [Dziobek and Pazarbasioglu (1997)].

[3] Banking crisis fueled by nonperforming loans are common in developed countries as well. The scope of these loans is generally more important in developing and emerging market economies, however. For instance peak levels of impaired loans averaged 49 percent of total loans in Indonesia, 48 percent in Thailand; while impaired loans have remained consistently below 10 percent in Nordic and most industrial countries, including during the period of banking and financial crises [Alexander et al. (1997)].

[4] For instance, at the peak of the financial crisis in Benin, 80 percent of total banks' loans portfolios, about 17 percent of GDP, was non-performing in the late nineties [Kane and Rice (2001)].

[5] For instance, Demirguc-Kunt and Detragiache (1998) classify episode of financial distress as full-fledged crisis if the ratio of nonperforming to total assets exceeds 10 percent.

much longer.[6] Substandard loans refer to loans which have been unpaid for six months at least and whose repayments cannot be undertaken by the debtor.[7] A different definition is used by the Central Bank of "Central African States", *Banque des Etats de l'Afrique Centrale* (BEAC) which considers as nonperforming all loans for which interest and/or principal have been left unpaid for a period of at least three months.[8] The criteria for identifying nonperforming loans is even more variable across Sub-Saharan Africa, if one takes into account the multiplicity of regulatory agencies and institutions across countries in the non-CFA sub-panel and the marked difference in the level of minimum capital requirement in these countries [Bloem and Gorter (2001)].[9] However, the Basel II Commission emphasizes the need to evolve toward a standardized and internal rating-based approach. In practice, this Commission recommends to align banks' capital requirements with prevailing modern risk management techniques [IIF (1999), BIS (2003)].[10] Moreover, to ensure comparability across banks, this Commission has established minimum qualifying criteria for the use of internal rating-based approaches that cover the comprehensiveness and integrity of banks' internal credit risk assessment capabilities. For all practical purposes, the definition used in this study is based on a shorter lead time to the substandard loan status and classifies as nonperforming all loans left unpaid for a period of at least 90 days.

The economic and financial costs of these impaired loans are significant.[11] Potentially, these loans may negatively affect the level of private investment, increase deposit liabilities and constrain the scope of bank credit to the private sector through a reduction of banks' capital, following falling saving rates as a result of runs on banks, accumulation of losses and correlative increased provisions to compensate for these losses. These loans also have potential for reducing private consumption, and in the absence of deposit guarantee mechanisms to protect small depositors, can be a source of economic contraction, especially when coupled with declining gross capital formation in the context of a credit crunch caused by erosion of banks' equity and assets.

The fiscal costs of these impaired loans are important as well, and vary with the scope and length of the crisis [Cortavarria et al. (2000)].[12] The resolution of these loans is generally made through the creation of Asset Management Companies and/or deposit insurance schemes whose main function is to take over nonperforming assets of distressed financial institutions. In most countries, these Asset Management Companies and deposit insurance

[6] BCEAO and BEAC were set up on the basis of two treaties establishing the Union Monétaire Ouest Africaine (UMOA), and a monetary co-operation between the Francophone states of Central and West Africa.

[7] By focusing on time and length of default, this definition allows classification of banks loans on the basis of their performances. Although practical, this definition fails to account for the relatively high degree of correlation between economic downturn and banking crisis. The risk exposure depends on the borrower, but also on its economic and brach of activity; the probability that a loan becomes nonperforming is higher when the economic branch in which the borrower exercises is exposed to unpredictable adverse shocks [Gonzalez-Hermosillo et al. (1997)].

[8] The classification also varies according to the type of loans, and is much longer for real estate loans.

[9] Some countries use quantitative criteria to distinguish between "good" and "bad" loans (e.g., number of days of overdue schedule payments), while others rely on qualitative norms (such as the availability of information about the client's financial status, and perspectives about future payments).

[10] Implementation of agreements under the Basel II Commission is ongoing. For the G10 countries, the transition toward the standardized and foundation for internal rating-based approaches is planned for year-end 2006.However, a more flexible approach is adopted for non-G10 countries whose banks are assisted by International Financial Institutions.

[11] "Impaired loans" is the accounting term for "nonperforming loans", and is used interchangeably with the latter throughout this paper.

[12] A study by the World Bank reported that the fiscal cost in some cases was between 1 and 2 percent of GDP—1.5 percent of GDP in Ghana, and 2.0 percent in Guinea, and much higher in other cases [Basu (1998)].

schemes are government-owned entities set up through the budget to provide financial assistance to problem banks [Gonzalez-Hermosillo et al. (1997)].[13] The intervention of these Asset Management Companies in support of distressed financial institutions to avert banking crisis may therefore exacerbate the already high pressure on government revenues. This pressure is likely to be more important in Sub-Saharan Africa where most countries are confronted with a narrow fiscal base and limited prospects for increased domestic resource mobilization.

When left unsolved, nonperforming loans can compound into financial crisis, the moment these loans exceed bank capital in a relatively large number of banks. In Sub-Saharan Africa, the probability of a banking crisis occurring may be even more important because nonperforming loan-related risks are compounded by the structure of the banking system which is dominated by a few large banks.[14] To the extent that the outbreak of banking crises is associated with rising scope of nonperforming loans, understanding the leading causes of these loans may be critical to improving the soundness of banks and financial institutions, and hence private investment and economic growth. However, despite the implications of nonperforming loans for banking crisis, for investment and economic growth, and for anticipating future banking and financial crises, the leading causes of these loans remain unknown for most countries in Sub-Saharan Africa. This paper investigates the micro and macroeconomic factors that led to the dramatic rise of nonperforming loans in Sub-Saharan Africa in the 1990s using pseudo-panel econometric models and discusses the macroeconomic implications of these loans for Sub-Saharan African countries.

The remainder of the paper is organized as follows. The next section provides an overview of the scope and trend of nonperforming loans in Sub-Saharan Africa, contrasting the CFA countries which operate under fixed exchange rate regimes with their currency pegged to the French franc, with non-CFA countries subject to flexible exchange regimes.[15] Section III investigates the determinants of nonperforming loans using correlation and causality analysis. The results highlight the significance of moral hazard, interbank loans, and a number of macroeconomic variables, including real interest rate, per capita GDP growth and inflation, which Granger-cause nonperforming loans. Section IV discusses the methodology for econometric estimation and provides an overview of the panel-based prediction model used in the context of this study. The results and macroeconomic implications of impaired loans for Sub-Saharan African countries are discussed in Section V. In particular, under fixed effects specification, the results support the significance of macroeconomic factors. Among these factors, GDP per capita and real effective exchange rates appear to have played a key role in the rapid accumulation of nonperforming loans in the 1990s, reflecting the extreme vulnerability of undiversified African economies to adverse macroeconomic shocks. Real exchange rate appreciation is particularly robust in explaining the proportional variance of nonperforming loans in the CFA sub-panel, through the balance of payments channels. At the microeconomic level, net interest margins and interbank loans are among the most significant

[13] The financial assistance provided by governments can take several forms, including a recapitalization schemes, acquisition of bad loans, assisted mergers and liquidity support.
[14] In Benin for instance, the whole banking system, which was dominated by three banks, collapsed when nonperforming loans averaged over 80% of banks' loans portfolio in the late eighties.
[15] Franc CFA refers to the Franc of African Financial Community or "*Franc de la Communauté Financiere Africaine"* (FCFA). The FCFA is used in 14 Sub-Saharan African countries (mostly former French colonies). These countries have their currency pegged to the defunct French franc; BCEAO and BEAC are the two Regional Central Banks for West and Central Africa, respectively.

predictors of nonperforming loans, reflecting the relatively low level of bank equity. Section VI provides some concluding remarks.

II. Nonperforming Loans in Sub-Saharan Africa

During the late 1980s and most of the 1990s, a large number of countries underwent episodes of systemic and borderline banking and financial crises across the developing world.[16] These crises, varying in scope across countries, were largely characterized by the poor performance of banking and financial institutions. They were largely associated with a rapid accumulation of nonperforming loans in the banking industry and a deterioration of asset quality in the face of increased credit risks. Over the decade spanning most of the 1990s, the scope of these loans increased significantly to reach over 30 percent of total loans in Sub-Saharan Africa. The peak was achieved in 1993, when they reached 32 percent of total loans, the highest in the developing world. Indeed, even during the height of the Asian Financial crisis in 1997, the aggregated share of impaired loans never exceeded 25 percent of total loans (see Figure 1).

Figure 1: Trend of Non-Performing Loans in percent of Total Loans by Region

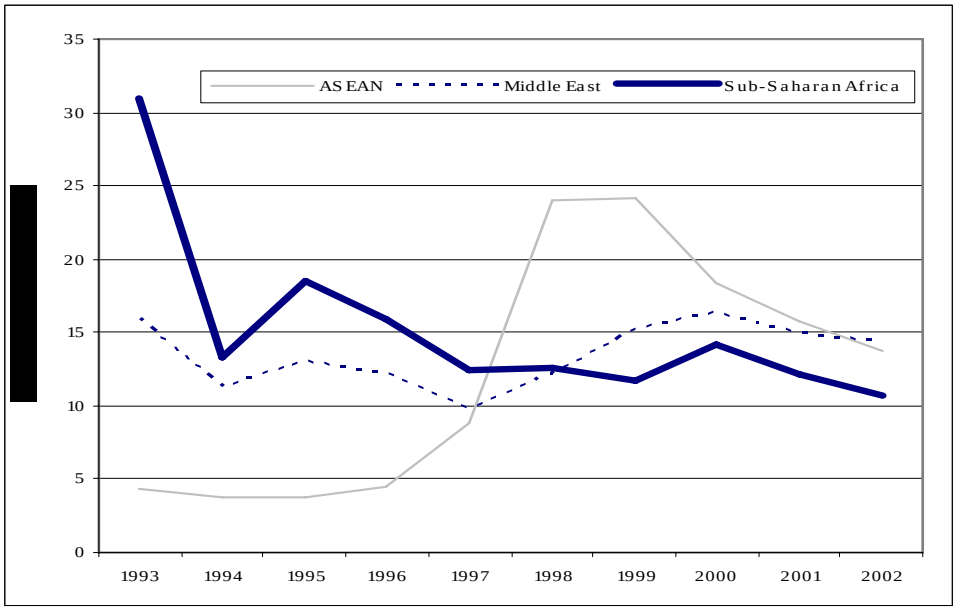


Figure 1 compares the trend of nonperforming loans in three regions of the developing world: Asia, Middle East and Sub-Saharan Africa. Solid dark line refers to Sub-Saharan Africa, light gray line refers to Asia and doted dark line refers to Middle East. The graphs show a massive accumulation of nonperforming loans in Sub-Saharan Africa, especially in the early 90s, an indication of poor asset quality and high credit risks. Expressed as a percentage of total loans, Sub-Saharan Africa recorded the highest share of these loans throughout the first half of the

[16] However, while much has been written about these crises in Latin America and Asia, the literature on banking crises in Sub-Saharan Africa has remained scant, see for instance Gonzalez-Hermosillo et al. (1997) for the financial crises in Latin America, and International Monetary Fund (1999) for the Asian financial crisis.

nineties, and up to 1997 during the outbreak of the Asian financial crisis. However, since then, that share has been declining steadily. By 2002, it accounted for about 12 percent of total loans, below the level observed in Middle East and Asia.[17] Although, nonperforming loans remain relatively high compared to estimates recorded in industrial countries where credit risk is generally below 10 percent [Barth and Nolle (1997)], this represents a significant improvement, reflecting the implementation of banking and financial sector restructuring undertaken in a number of countries, and direct capital infusion and government support largely in the form of acquisition of bad loans at a discounted price [Basu (1998)].

Notwithstanding the relative decline of these impaired loans— sign of a relative improvement of banks position— the financial costs and implications of these loans remain far too important with lasting consequences for most of the heavily indebted poor countries and small economies of Sub-Saharan Africa. In dollar terms, the financial costs of these loans exceeded US$6 billion in Sub-Saharan African countries in 2002. Though the overall estimated dollar amount associated with these loans is much higher in other regions of the developing world, their share of GDP is significantly much smaller, especially for Asia, owning to the smaller size of the economy for most countries in Sub-Saharan Africa where on the aggregate these loans account for about 2% of GDP [Basu (1998)].[18]

The dynamics of these impaired loans shows important disparities between countries in the CFA and non-CFA sub-panels, with significantly higher costs for the latter panel. Figure 2 compares the trend of these loans in the sub-panels of CFA and non-CFA countries. The solid and dark line refers to averages across countries in the CFA sub-panel and the light gray line refers to averages across countries in the non-CFA sub-panel. While the financial costs of these loans grew consistently for countries in the non-CFA sub-panel over most of the 90s, increasing from less than US$50 millions in 1993 to over US$6 billion dollars in 1999, before tapering off thereafter, a reversal in the rising trend was observed in 1996 for countries in the CFA sub-panel, largely reflecting the exchange rate effects following the nominal devaluation of the CFA franc.

The dramatic increase in the financial costs of these loans during the period preceding the devaluation of the CFA franc in 1994 was followed by a steady decline afterward.[19] Correlatively, between 1996 and 2002, the financial costs of these loans for countries in the CFA sub-panel failed from over US$275 millions to less than US$200 millions, leaving still a considerable gap between the sub-panel of CFA and non-CFA countries. The declining trend was of short span however. Since 1999, the estimated costs of these loans have been on the rise. The latest figures indicate that they increased from less than US$150 millions to over US$200 million between 1999 and 2002.

This large gap is probably a reflection of the size of these economies, the structure of the banking system, and the difference in the scope of the crisis across the CFA and non-CFA

[17] Note that the cross-over path between Sub-Saharan Africa and Asia, where a declining trend in Sub-Saharan Africa is mirrored by a rising trend in Asia, occurs in 1997 during the Asian financial crises. In a number of countries, Indonesia and Thailand, nonperforming loans accounted for about 50 percent of total loans during that crisis [Alexander et al. (1997), Cortavarria et al. (2000)].

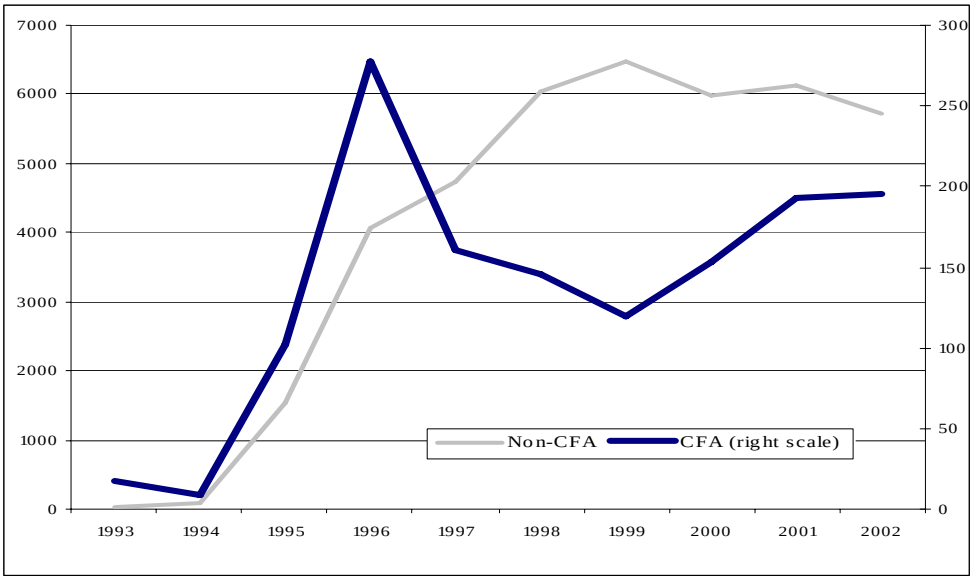
[18] The estimated costs are around US$17.6 billion for Middle East and over US$41 billion for Asia, accounting for 2.6% of GDP and 0.0015% of GDP, respectively.

[19] The CFA franc which has been pegged to the French franc at the fixed parity of 1 French franc to 50 CFA franc since 1945 underwent a 100 percent devaluation in 1994, establishing the new parity of 1 French franc to 100 CFA franc. For further details see [Tchundjang Pouémi (1979), Monga and Tchatchouang (1996) and Monga (1997)].

sub-panels. The countries which were most affected by the crisis included Benin, Cameroon, Guinea-Bissau, Kenya, Nigeria, Senegal and Swaziland.[20] In most of these countries, banks witnessed a dramatic erosion of their equity and capital. For instance, at the end of 1996, these loans accounted for over 30 percent of total loans in Cameroon; in Guinea-Bissau, they accounted for over 45 percent of commercial banks' total loans portfolios in 1995; in Kenya, financial institutions accounting for over 30 percent of total assets faced solvency problems between 1993 and 1995.[21] Interesting enough, the countries most affected by the crisis also exhibited the lowest ratio of equity to liquid assets, an indication of a fragility of banks, which often resort to short-term financing. In particular, Swaziland and Benin have the lowest ratio; about 14% and 20%, respectively (see Table 1 in the Annex).

The financial cost of the crisis was variable across countries. For instance, in Kenya, the 16 distressed financial institutions closed or taken over by the Central Bank of Kenya in the early 90s had assets and deposits of about US$370 million and total losses of about US$158 millions.[22] In Senegal and Côte d'Ivoire where the magnitude of the crisis was also significant, the estimated losses were much smaller in absolute terms, yet much higher when expressed in terms of GDP, reflecting the size of these economies. They accounted for over 17 percent of GDP in Senegal and about 25 percent of GDP in Côte d'Ivoire in the late 80s and early 90s, respectively [Caprio and Klingebiel (2002)].[23]

Figure 2: Non-Performing Loans (in Millions of US dollar) in Sub-Saharan Africa: Contrast between Sub-panels of CFA and non-CFA countries



[20] The magnitude and length of the crisis was particularly significant in countries which experienced systemic financial crises in the 1980s and 1990s (Cameroon, Kenya and Senegal) and during most of the 1990s (DRC and Nigeria).
[21] In Senegal, about 50 percent of banking system loans was nonperforming in the late 80s and early 90s [Husain and Faruqee (1994)].
[22] For further details, see Central Bank of Kenya Monthly Economic Review (1995).
[23] Although most countries in Sub-Saharan Africa were affected in the 90s, the financial crisis broke out much earlier in a number of countries, including Benin (1988), Equatorial Guinea (1983), Tanzania (1987), and Senegal (1988). The crisis had a devastating effect in Senegal where six commercial banks and one development bank accounting for over 30% of financial system assets were forced to close.

The structure and composition of these nonperforming loans comprises of investment in speculative projects, loans extended to real estate development and short-term loans to finance investment projects that could not generate enough income in the short run to cover interest payments. During the economic crisis fueled by the deterioration of terms of trade and exogenous shocks (falling commodity prices), which affected numerous countries in the 1990s, banks accumulated a sizable share of impaired loans to agricultural and export sectors in the form of credit facilities for trade and direct investment. For instance, banking and financial institutions, which suffered heavy losses, were the leading cocoa and coffee exporters in Cameroon and Côte d'Ivoire, two agrarian-based economies which derive a sizable share of export earnings from agriculture. These countries experienced a significant deterioration of terms of trade during the crisis period.[24]

There are several other explanations for the rise of impaired loans in the 1990s: the chronic fiscal deficits and balance of payment difficulties in numerous countries, the mismatch between the maturities of assets and liabilities, which led numerous banks and financial institutions to resort to highly-priced short-term financing in the form of interbank loans. The demand for highly-priced short-term loans further exacerbated the crisis and the accumulation of impaired loans. In some of the most affected countries where governments were the main shareholders, a sizable share of impaired loans was owed by state governments and government agencies and institutions. This was quite common across Sub-Saharan Africa during most of the 1980s and 1990s where commercial banks were heavily involved in the financing of government fiscal deficits and loss-making public enterprises [Basu (1998)].

The depth of the banking crisis is further illustrated by the deterioration of banks assets, proxy by the capital asset ratio, a measure of asset quality. This ratio provides the cushion to absorb shocks in crisis periods; a large value of this ratio is an indication of a relative soundness of banks and financial institutions. While the overall estimate for this ratio exceeds the 8 percent minimum requirement— set within the framework of International Settlement Standards— for a number of countries, this threshold is not met, especially in the CFA sub-panel of countries where the overall average is about 7 percent. This ratio is slightly higher in the sub-panel of non-CFA countries which have an overall average above 15 percent (see Table I). The difference between the sub-panels of CFA and non-CFA countries is preserved when conditioned upon the ownership structure of banks (public versus private). For publicly-owned banks, the capital asset ratio is 29 percent for countries in the non-CFA sub-panel, about twice the level in the CFA sub-panel of countries. Surprisingly, for privately-owned financial institutions, these ratios are much lower, 14 percent for the sub-panel of non-CFA and about 7 percent for the sub-panel of CFA (see Table 2 in the Annex).

The relatively low capital to asset ratio among private banks illustrates the magnitude of credit risks to financial institutions and the relatively low level of equity, a constraint to the constitution of provisions against future losses and potential risks. Indeed, the ratio of nonperforming loans to loan loss reserves and provisions is much higher for privately owned banks and financial institutions across Sub-Saharan Africa. For instance, while these loans account for over 450 percent of loans loss reserves for all privately-owned financial

[24] Terms of trade deterioration were estimated to about 56 percent in Cameroon in the late 1980s and over 27 percent in Côte d'Ivoire in the early 1990s.

institutions; they account for about 190 percent for publicly-owned financial institutions. Irrespective of the ownership structure, the gap between countries in the sub-panels of CFA and non-CFA remains important. For privately-owned financial institutions, this ratio varies between 350 percent for non-CFA to over 570 percent for the CFA sub-panel, implying that either nonperforming loans are much higher in the CFA sub-panel and/or provisions for losses are kept low to artificially inflate the capital base of banks. However, given the significantly higher financial costs of these loans and their magnitude for non-CFA countries, the difference in these ratios may partly reflect the level of banks' provisions in the sub-panel of CFA countries.[25]

Table I: Banks Portfolio and Assets Structure in Sub-Saharan Africa (Averages over 1993-2002)

Countries	NPL/LLR	NPL/LLP	Capital Asset ratio	Return on Assets	DEP/LOAN	DEP/LIAB
Benin	1.706	7.127	0.070	0.015	2.896	0.926
Botswana	1.157	3.653	0.196	0.045	1.698	0.801
Cameroon	..	1.603	0.063	0.001	1.874	0.916
Cape Verde	2.639	5.000	0.079	0.012	2.470	0.852
Chad	1.000	0.250	0.139	0.011	1.288	0.871
Côte d'Ivoire	1.894	3.333	0.090	0.012	1.195	0.904
Ethiopia	1.140	1.917	0.099	0.015	2.596	0.702
Kenya	2.787	6.532	0.148	0.016	1.489	0.849
Malawi	2.167	0.833	0.139	0.021	2.766	0.813
Mali	1.385	12.679	0.093	0.008	1.662	0.944
Rwanda	1.867	1.500	0.113	0.015	1.861	0.874
Senegal	2.585	2.473	0.082	0.011	1.516	0.893
South Africa	1.316	3.234	0.325	0.030	1.679	0.660
Swaziland	1.891	5.500	0.059	0.001	9.728	0.636
Togo	1.517	3.973	0.109	0.015	1.548	0.917
Zimbabwe	1.056	3.387	0.205	0.041	1.985	0.727
All CFA	**1.681**	**4.491**	**0.092**	**0.010**	**1.711**	**0.910**
All Non-CFA	**1.780**	**3.321**	**0.151**	**0.022**	**2.919**	**0.768**
All SSA	**1.740**	**3.833**	**0.126**	**0.017**	**2.391**	**0.830**

The scope of nonperforming loans is particularly high for banks and financial institutions, which have loans portfolios skewed toward manufacturing, commerce, and services. This is particularly the case for member countries of the West African Monetary Union. Consistently, nonperforming loans to these three sectors account for over 75% of problems loans [UMOA (2000, 2001)]. Moreover, these loans have short term maturity and are largely directed toward commerce, which accounts for over 40 percent of total impaired loans. Although the pattern and trend are consistent across countries, the contribution of these three sectors to the growth of impaired loans is more important in Benin where it averages 90% over the 90s. The distribution across sectors is also variable; nonperforming loans to services have longer maturity and are higher in Burkina Faso and Benin. Expressed as a percentage of total impaired loans, they range from 15 to 29% in Burkina Faso and from 28 to 39% in

[25] In spite of the relative increase in the level of provisions in the sub-panel of CFA countries, members of the Central African Monetary Union (BEAC), the coverage ratio which was below 50 percent in the early 1990s, increased to over 60 in the second half of the 1990s, a level that remains relatively low, however [COBAC (1996, 1998)].

Benin [UMOA (2001)]. The share of nonperforming loans to the service sector is much lower in other countries, especially in Mali, where it consistently accounts for less than 10% of the total portfolios of problems loans. Most impaired loans in this country are owed to the agricultural and fishing sectors, which account for 53 percent of all problems loans [UMOA (2001)], a reflection of high vulnerability of banks to undiversified economies.

III. Determinants of Nonperforming Loans: Stylized Facts and Causal Analysis

The accumulation of nonperforming loans is generally attributable to a number of factors, including economic downturns and macroeconomic volatility, terms of trade deterioration, high interest rates, excessive reliance on overly high-priced interbank borrowings, insider lending and moral hazard [Goldstein and Turner (1996)].[26] In a context of low equity and absence of diversification, terms of trade deterioration and interbank loans played a key role in the accumulation of nonperforming loans in Sub-Saharan Africa. The latter also increased the risks and prospects of moral hazard. Moral hazard in the banking sector context refers to the adverse incentives created by the prospects of implicit coverage of banks losses by governments. It can be particularly high when banks' capitalization is low; in such cases, it often leads to adoption of imprudent lending strategies with direct implications for banks' loans portfolios which tend to be heavily skewed toward high risk projects. When these projects are owned by investors and entrepreneurs directly or indirectly connected with the lenders, the financial transaction is termed as insider lending.[27]

The minimum capital requirement for banks remains relatively low during most of the 80s and beyond, a deliberate policy adopted by countries in support of the emergence of a domestic banking system. In light of the inverse relationship between moral hazard and banks' capital, this deliberate policy exacerbated the banking crises and its inherent costs for Sub-Saharan African countries, however [Brownbridge (1998)].[28] Indeed, moral hazard was pervasive in the practice of banking in the nineties, and at such was singled out as one of the leading causes of a dramatic increase of nonperforming loans. In Nigeria for instance, moral hazard which fueled insider lending is believed to have accounted for over 65 percent of impaired loans in four banks liquidated in 1995. Similarly, most of large local banks failures in Kenya involved extensive insider lending [Bronwbridge (1998)].

This section investigates the determinants of nonperforming loans using correlation and causality analysis. The analysis is based on data drawn from 16 African countries (7 CFA and 9 non-CFA). The sub-panel of CFA countries includes: (1) Benin, (2) Cameroon, (3) Chad,

[26] With the distressed financial system, interbank borrowings became the source of funds for most financial institutions. In Nigeria for instance, two of the failed Merchant banks had mobilized 84% and 68% of their total deposit liabilities from interbank deposits, respectively [Manu (1994)], a situation that led to rapid increase in interest rate. Real interest rates at over 20 percent were not uncommon for interbank borrowings.

[27] Insider lending is not specific to Sub-Saharan Africa however; over the years, it has been singled out as the major cause of banks failure around the world [Caprio (1997)].

[28] For instance, during that period, the minimum capital requirement was less than US$50,000 in smaller countries and no more than half a million dollars in larger economies such as Kenya and Nigeria. However, an increase in the capital requirement and banks capitalization was part of the restructuring measures. Over the past few years, capital requirements have been significantly increased in most countries. For instance, in Kenya, all banks were obliged to raise their minimum capitalization from US$1.2 million to US$3.2 million in 1999. Since then this amount has been increased further. Similar measures were undertaken in other countries in Sub-Saharan Africa. In late 2004, the Central Bank of Nigeria announced a new minimum capital requirement of over US$180 million, representing more than 1150% increase from its previous level of US$14.5 millions.

(4) Cote d'Ivoire, (5) Mali, (6) Senegal and (7) Togo. The sub-panel of non-CFA countries includes: (8) Botswana, (9) Cape Verde, (10) Ethiopia, (11) Kenya, (12) Malawi, (13) Rwanda, (14) South Africa, (15) Swaziland and (16) Zimbabwe. The sample selection is dictated by the scope of the database and availability of financial information on these countries.[29] The data are provided on an annual basis end-of-period, between 1993 and 2002, included. The minimum length of the panel covers a period of 3 years for the shortest series (Chad and Rwanda), and up to 10 years for the longest series, producing an unbalanced panel.

The correlation and causality analysis focuses on a number of macroeconomic and microeconomic (banking-sector) variables. At the macroeconomic level, the study investigates the correlation between nonperforming loans and a subset of economic variables: per capita GDP, inflation, interest rates, changes in the reel exchange rate, interest rate spread and broad money supply (M2). At the microeconomic level, it focuses on the association between nonperforming loans and banking-sector variables. The key banking variables include return on asset and equity, net interest margins and net income, and interbank loans. These variables are chosen in light of theoretical considerations and subject to data availability. Nonperforming loans are adjusted for specific provisions (nonperforming loans as a proportion of loans loss provisions) to provide the basis for cross-country comparisons.

For a full coverage, the analysis is carried out for all banks, public and privately-owned banks (see Table II). A disaggregation along the lines of CFA and non-CFA sub-panels is also considered to capture regional effects of banking crises (see Table 3 and 4 in the Annex). The results show a negative association between real GDP per capita and nonperforming loans expressed as a percentage of loans loss provision. This implies that falling per capita income is associated with rising scope of nonperforming loans. To the extent that changes in per capita income is proxy for changes in economic growth, the negative association with nonperforming loans may reflect the impact of cyclical output downturns on the banking sector; a result that is expected in the literature [Gonzalez-Hermosillo (1999)]. The sign of the coefficient is consistent across state and private banks, though the magnitude of the correlation is stronger for state banks and financial institutions.

The study also investigates the association between nonperforming loans and, domestic credit, broad money supply (M2) and inflation. Though the magnitude of the coefficient of correlation between inflation and nonperforming loans is low, the sign is negative; unexpected rise in inflation under cyclical downturns is likely to negatively affect the performance of the banking sector and recovery of loans to private operators and investors. In the extreme case, hyper-inflation may erode banks assets and equity and weaken banks position through the interest rate channel. However, the magnitude of the coefficient is relatively low, and may reflect the general context of declining inflationary pressures in the nineties, especially in the sub-panel of CFA countries.[30]

The results also show a positive association between real exchange rate appreciation and nonperforming loans. The magnitude of this association is particularly strong in the sub-panel of CFA countries, which underwent a devaluation of their currency in the early nineties. Real

[29] Bankscope collects data on individualized banks portfolio and assets structure, including nonperforming loans.
[30] With few exceptions, the average CPI inflation rate was relatively low in the CFA monetary zone, which offers a limited room for independent monetary policy, and hence little scope for inflation through money supply [Husain and Faruqee (1994), Monga and Thatchouang (1996)].

exchange rate appreciation may limit growth prospects by squeezing profit margins, especially in export-oriented industries, and ultimately lead to economic contraction with direct implications on loans performance [Kaminsky and Reinhart (1996)].[31] The direction of the association between real exchange rate appreciation and nonperforming loans is not consistent throughout the sample, however. This relationship is ambiguous for the sub-panel of non-CFA countries. In spite of its magnitude, the coefficient associated with these countries has a negative sign. Clearly, while the sign and direction of the association with banking crisis in the period preceding the crises may be anticipated, the response of monetary authorities is likely to affect the nature of this relationship over the crisis period, and may partly explain the ambiguous nature of the relationship in this sub-panel.

Table II: Correlation Analysis between Nonperforming Loans (in % of loan loss provision) and Selected Banking and Macroeconomic Variables

Variables	All Banks	State Banks	Private Banks
MACROECONOMIC VARIABLES			
Real GDP growth rate	0.19	-0.32	0.09
Real GDP per capita	-0.22	-0.63	-0.22
M2 in % of GDP	-0.03	0.07	-0.07
CPI inflation rate	-0.13	0.11	-0.17
GDP deflator inflation rate	0.01	0.19	-0.28
Domestic credit provided by banks (in % of GDP)	0.11	0.42	-0.11
Real interest rate	-0.14	0.00	0.09
Interest rate spread	-0.20	0.29	-0.14
Real GDP growth rate 2	0.24	-0.33	0.16
Real GDP per capita 2	-0.22	-0.60	-0.20
CPI inflation rate 2	-0.13	0.11	-0.17
BANKING VARIABLES			
Equity (in % of total asset)	-0.01	-0.49	0.13
Return on asset	-0.14	-0.59	-0.28
Total deposit (in % of total assets)	-0.12	-0.18	0.11
Total deposit (in % of total liabilities)	0.01	0.28	-0.08
Return on equity	-0.29	-0.70	-0.17
Net interest margin	-0.26	-0.60	-0.13
Net income (in % of total revenue)	-0.11	-0.47	-0.27

Equally interesting is the relationship between broad money multipliers (M2) and nonperforming loans, and the potential association between banking crisis and domestic credit to the private sector. Theoretically, credit to the private sector is expected to grow more rapidly in the periods preceding the crises. However, the lending boom in the pre-crisis period is generally followed by a fall in domestic credit in the outbreak of the crisis [Gavin and Hausman (1995)]. With falling domestic credit, financial intermediation, measured by the ratio of broad money (M2) to GDP, is expected to be low, suggesting a negative

[31] There are other indirect channels through which the economy and the banking sector can be affected: the exchange rate regime can undermine bank soundness through its impact on vulnerability to speculative attacks, a downward adjustment in the real value of bank capital, and the ability of the central bank to act as lender of last resort.

association between nonperforming loans and M2. Consistent with theoretical underpinnings, a large number of countries, especially the most affected ones (Benin, Cameroon and Côte d'Ivoire) witnessed a significant decline in the volume of credit to private sector during the banking crisis in most of the 90s [Daumont et al. (2004)].

Indeed, the data analysis shows a negative association between monetary expansion— proxy by credit to the private sector— and nonperforming loans. This result is consistent across the sub-panels of CFA and non-CFA countries. It is particularly robust for CFA countries, which have a relatively high coefficient of correlation (see Table 3 in the Annex). However, the results are more ambiguous for state-owned banks, which exhibit a positive association between domestic credit and nonperforming loans. This may suggest that numerous problems banks owed by governments continued to operate and contribute to the growth of domestic credit; and to the extent that state-owned banks have traditionally been among the largest in Sub-Saharan Africa, the negative association may reflect the delay in the implementation of financial and operational restructuring measures and the "too large to fail" policy that prolong the life of banks and financial institutions which otherwise would be declared bankrupt [Gonzalez-Hermosillo et al. (1997)].

At the microeconomic level, the correlation analysis shows a negative association between nonperforming loans and most banking variables, including return on asset and equity, total deposit, net interest margin and net income (see Table II). This result is consistent for most countries in the sub-panel of CFA and non-CFA countries (see Table 3 and 4 in Annex), and between state and privately-owned banks. For instance, the coefficient of correlation between return on asset and nonperforming loans is about -14 percent for all banks; it is higher in absolute terms for private banks (-28 percent) and state banks (-59 percent). A coefficient of correlation this high suggests that about 60 percent of variations in the scope of nonperforming loans are explained by changes in return on assets. However, a correlation analysis does not necessarily imply causation.

The correlation analysis is further complemented by a Granger Causality to investigate the direction of and a possible causal relationship between a number of key explanatory variables and nonperforming loans.[32] A time series v is said to Granger-cause w if statistically significantly better predictions of w can be made by including lagged values of v in the conditioned information set in addition to lagged values of w [Granger (1969), Agénor and Taylor (1992)]. Let $\tilde{w}_t$ be the vector of nonperforming loans transformed to stationarity and $\tilde{v}_t$ the value of a given explanatory variable taken at time t $(0 < t \leq T)$, the length of the time series. The vector $\tilde{v}_t$ is said to Granger-cause $\tilde{w}_t$ if lagged values of $\tilde{v}_t$, $(l\tilde{v}_t = \tilde{v}_{(t-l)})$ significantly help in the prediction of $\tilde{w}_t$, given lagged value of $\tilde{w}_t$. Formally, the Granger test of causality can be analyzed from the following bivariate representation:

$$\tilde{v}_t = \alpha_0 + \alpha_1 \tilde{v}_{(t-1)} + \cdots + \alpha_l \tilde{v}_{(t-l)} + \beta_1 \tilde{w}_{(t-1)} + \cdots + \beta_l \tilde{w}_{(t-l)} + \varepsilon_t \qquad (1)$$

$$\tilde{w}_t = \alpha_0 + \alpha_1 \tilde{w}_{(t-1)} + \cdots + \alpha_l \tilde{w}_{(t-l)} + \beta_1 \tilde{v}_{(t-1)} + \cdots + \beta_l \tilde{v}_{(t-l)} + \mu_t \qquad (2)$$

[32] The standard Granger-causality test is designed to analyze bivariate stationary stochastic processes.

The explanatory variable is represented in a synthetic form and could take on the representation $(\tilde{v}_{it})$ where the subscript i in turn represents macroeconomic and microeconomic level variables and t is the length of the series. The variables ε_t and μ_t are vectors of error terms. A causal relationship exists between $(\tilde{w}_t, \tilde{v}_t)$ if at least one of the estimated regression coefficients $\beta_l \neq 0$ in equation (2), $(0 < l \leq n)$ where n is the maximum number of lags in the model.[33] This implies that $f(\tilde{w}_t \mid \tilde{w}_{(t-1)}, \tilde{v}_{(t-1)}) \neq f(\tilde{w}_t \mid \tilde{w}_{(t-1)})$. In other words, understanding the dynamics of nonperforming loans would be improved by conditioning on a number of explanatory variables.

The Granger-Causality test is applied to the sample of countries. The results are provided in Table 5a and 5b in the Annex. At the macroeconomic level, inflation, real interest rate, growth rate of GDP per capita are Granger-causal to nonperforming loans across most countries. In a number of countries, the *F-Statistics* is extremely large, with the null hypothesis of lack of causality rejected at 1 per cent level of significance. This is particularly the case for Cameroon and Chad. For these countries, the significance of real interest rate in the prediction of nonperforming loans reflects the prohibitively high level of interest rates which came with banks deregulation in the 80s. The positive covariance structure between real interest rates appreciation and rise of nonperforming loans is expected and has been observed in other parts of the world [Gonzalez-Hermosillo (1997)].[34] Indeed, interest rate liberalization increases the costs of funds and nurtures the culture of high-risk behavior; and to mitigate risks, higher rates are charged to high-risk borrowers, hence further increasing banks overall exposure.

The coefficient associated with inflation is also significant in most countries, implying that inflation Granger-causes nonperforming loans. Indeed, inflation is one of the most significant macroeconomic variables in Chad, Kenya and Zimbabwe. The coefficient associated with this predictor has the largest *F-Statistics* in these three countries. While the significance of this variable in Zimbabwe may reflect the hyper-inflation context fueled among others by acute shortage of supply partly driven by the dramatic economic and political crisis in the late 90s and beyond, its significance in Chad, a CFA country, may reflect inflationary pressures in the aftermath of the CFA devaluation in the mid-90s. In some of these countries, inflation is thought to have contributed to a rapid erosion of banks assets [Brownbridge (1998)].

However, in few countries, inflation and real interest rate are not particularly significant and do not appear to Granger-cause nonperforming loans. For these countries, the dynamics of nonperforming loans is best explained by the growth rate of GDP. For instance, in Botswana where growth rate of GDP Granger-causes nonperforming loans, the F-Statistics has an extremely large value. The Granger test also reveals a dual causality between growth rate of GDP per capita and nonperforming loans, implying that economic contraction and cyclical downturns may negatively affect banks portfolio, possibly leading to a deterioration of asset quality and accumulation of impaired loans. Conversely, banking crisis and accumulation of

[33] A two-way causation is also possible and may occur if at least one of the $\hat{\beta}_l$ in equation (1) is different from 0.

[34] In a study on the determinants of banking system fragility in Mexico, Gonzalez-Hermosillo et al. found that high and prohibitive interest rate tend to lower the survival time of problems banks.

nonperforming loans may contribute to economic downturns, possibly through the saving-investment link channels and/or the fiscal channel.

At the microeconomic level, measures of profitability (net interest margins and returns on assets) play a key role in explaining the causal link between nonperforming loans and banking sector variables. In particular, net interest margin is significant across the sub-panel of CFA and non-CFA countries, and Granger-causes nonperforming loans at one and in some cases up to two lags (see Tables 5a and 5b in Annex). This variable is significant at 1 percent level. Similarly, the variable returns on assets Granger-causes nonperforming loans in most countries. In Kenya where the null hypothesis of non causality is rejected at 1 percent level, it has a relatively large *F-Statistics*.

Other key microeconomic determinants of nonperforming loans include "equity over total liquid assets" and interbank loans over total assets. These variables may also be viewed as proxy for moral hazard, to the extent that the recourse to highly-priced short-term loans may be an indication of erosion of bank capital and/or a reflection of a relatively low equity base. Indeed, in spite of their prohibitively high costs, interbank loans are heavily used during most of the crisis period. This variable is shown to Granger-cause nonperforming loans in a number of countries, including Botswana, Cameroon, Côte d'Ivoire, Mali and South Africa. The unidirectional causality of interbank loans suggests that the recourse to short-term financing at a high price might indeed have exacerbated the scope of banking crisis by contributing to a rapid accumulation of nonperforming loans, through the moral hazard channel that extended the operations of problems banks, and hence, the cost of the crisis.[35] The next section investigates the predictability of these variables in explaining the dynamics of nonperforming loans using pseudo-panel estimation techniques.

IV. Econometric Estimation and Prediction Model

The estimation is based on pseudo-panel (unbalanced panel) models. A panel is said to be unbalanced when observations on different groups do not cover the same time period. Indeed, the time series provided by Bankscope is not uniform across the subset of countries. The series is shorter for a number of countries, and when the length of the data covers the entire reference period for most countries, missing values are observed in a few cases. This configuration has motivated the use of pseudo-panel models, which are especially suitable for econometric analysis in presence of missing values. There are several specifications for these models; this study uses the specification represented by equation (3) below.

$$w_{it} = \lambda_i + \beta' V_{it} + \varepsilon_{it} \qquad (3)$$

Where w_{it} is the dependent variable, representing nonperforming loans expressed as a proportion of loan loss provisions. The variable V_{it} is a non-constant vector of i regressors, for $i = 1,2,\cdots N$. Each cross-section unit is observed for a period t, with $t = 1,2,\cdots,T$, and varying across countries. The study focuses on fixed effect estimation, which allows the

[35] Indeed an extension of operations carried out by troubled banks and financial institutions through access to short-term financing can only exacerbate the crisis, especially if not accompanied by a systematic operational restructuring of banks coupled with portfolios restructuring.

constant parameter λ_i to differ across cross-section units. These effects are derived by stacking observations in each group to produce the following representation:

$$W_{i,T_i} = \lambda_i \tau_{T_i} + V_{i,T_i}\beta + \varepsilon_{i,T_i} \qquad (4)$$

The model assumes that differences across unit are captured in differences in the constant terms. The fixed-effects parameters in equation (4) are therefore estimated by maximizing the group-specific likelihood function represented by equation (5) as follows:

$$l(\psi_i) = -\frac{T_i}{2}\log(2\pi\sigma_i^2) - \frac{1}{2\sigma_i^2}\varepsilon_i'\varepsilon_i \qquad (5)$$

Under error variance homogeneity, the above specified likelihood function can be represented as follows:

$$l(\psi_i) = -\frac{T}{2}\log(2\pi\sigma^2) - \frac{1}{2\sigma^2}\sum_{i=1}^{N}\varepsilon_i'\varepsilon_i \qquad (6)$$

Where $T = \sum_{i=1}^{N} T_i$.

These models are also very flexible and suitable for prediction.[36] In order to further the causality analysis and assess the potential impact of microeconomic changes and macroeconomic volatility on the performance of the banking sector, the dynamics on these loans are investigated in the post-2002 period between 2003 and 2010 under certain assumptions (high and low case scenario). The dynamic of these loans is analyzed from the prediction model specified by equation (7) below. These predicted values are based on fixed effects estimates conditioned upon the estimated coefficients associated with the initial predictors, producing the following functional representation.

$$\hat{f}_j(w_{j,t}) = \hat{\lambda}_i^{fe} + f(w_{i,t} \mid \hat{\beta}, V_{i,t}^m, \overline{V}_{i,t}^m, V_{i,t}^M, \overline{V}_{i,t}^M) + \varepsilon_{i,t} \qquad (7)$$

The vectors $\overline{V}_{i,t}^m$ and $\overline{V}_{i,t}^M$ are assumed constant over the prediction range. The constant $\hat{\lambda}_i^{fe}$ represents the fixed effects estimation for a given country i. The matrix $V_{i,t}^m$ is comprised of micro (banking-level) predictors; the matrix $V_{i,t}^M$ is comprised of macroeconomic

[36] They offer several other advantages in addition to their potential for analysis and the measurement of dynamics; they also have the ability to improve the precision of aggregate estimates, and can be used for prediction [Deaton (1997)].

predictor variables associated with country i and varying over the time period t. For instance, the variables falling under $V_{i,t}^{M}$ include real interest rates, per capita GDP and inflation, and the ones falling under $V_{i,t}^{m}$ include returns on asset, interbank loans and net interest margins. In turn, the effects of these variables on nonperforming loans are assessed either sequentially, taking each variable at the time, or jointly assuming a concurrent variation of micro and macroeconomic variables.[37]

The macroeconomic effects are assessed by assuming changes in given macro variables $V_{i,t}^{M(k)}$, holding all other variables constant at their average and historical values. For instance, when the emphasis is on inflationary effects, other macro variables are kept constant at their average values over the reference period, while microeconomic variables are equal to actual historical data. Likewise, microeconomic effects are assessed by holding the macroeconomic variables constant. On the other hand, micro and macroeconomic changes are also expected to affect the behavior of nonperforming loans concurrently. These potential joint effects are assessed by allowing a simultaneous variation in a set of banking and macroeconomic variables over the prediction range. In order to improve the prediction, a confidence interval is built around the conditional prediction function using variance estimation from the pseudo-panel model.

V. Empirical Results and Macroeconomic Implications

Pseudo-panel models are applied to the full sample and sub-samples of countries in the sub-panels of non-CFA and CFA countries.[38] The full sample uses 16 cross-sections in a total unbalanced panel of 90 observations. The sub-panel of CFA countries uses 7 cross-sections in a total number of 46 observations. The sub-panel of non-CFA countries uses 9 cross-sections in an unbalanced panel setting of 44 observations. The results derived from these models are shown in Table III (full sample). The results for the sub-panels of CFA and non-CFA countries are shown in Tables 5a and 5b in Annexes. Table III summarizes these results for the full model with estimated parameters for group specific constant term in the fixed effects panel and the coefficients associated with the given explanatory variables.

The pseudo panel models support the fixed effects estimation for the full sample and across the sub-panel of CFA and non-CFA countries. The fixed effects approach which takes λ_i to be a group specific constant term in the models reject the null hypothesis that these country-specific intercepts are the same. In fact, the extremely low probability values for the overall *F-Statistics* suggest that fixed effects estimates are more appropriate. For the full sample, the *F-statistics* is about 3.3, much larger than the 5 percent critical value.[39] The differences

[37] Clearly, joint effects are more likely; macroeconomic volatility (whether driven by monetary, fiscal or external factors) and banks portfolios effects (whether measured by profitability, asset quality and credit risks) are dependent upon economic growth and macroeconomic stability and may occur concurrently, affecting the overall dynamic of nonperforming loans.

[38] One of the key advantages of panel data is that it provides researchers with greater flexibility in modeling differences across countries; they can also be used to study the dynamics of response variable over time.

[39] In the fixed effects model, researchers make inferences conditional upon effects observed in the sample, unlike random effect models from which unconditional inferences are made with respect to the entire population.

across countries also hold at the 1 percent critical level for the full panel and sub-panel of CFA countries which have even lower probability values.

The significance of individual regressors in explaining the dynamics of nonperforming loans over the reference period can be tested using the results, *t-statistics* for each coefficient and the corresponding probability values reported in the last column of Tables III (for the full panel), Table 5a (sub-panel of CFA countries) and Table 5b (sub-panel of non-CFA countries). These results highlight a considerable variation across countries in terms of factors affecting the dynamics of nonperforming loans. Macroeconomic volatility seems to play a significant role in the rise of impaired loans. The results are consistent for the full panel and across the sub-panels of CFA and non-CFA countries. For the full panel, the most significant macroeconomic variables include change in effective exchange rate, GDP per capita, real interest rate and broad money (M2); a result that is consistent with the correlation and causality analysis. These variables have the lowest probability values, well below the 5 percent level in the three panels.

Table III: Determinants of Non-performing Loans across Sub-Saharan Africa (Panel Results)

Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Equity (% of total assets)	23.33263	15.22513	1.532507	0.1307
Return on asset	-50.91718	50.86922	-1.000943	0.3209
Net interest margin	-58.76857	19.97444	-2.942189	0.0046
Net income (% of total revenue)	-1.667656	3.075736	-0.542197	0.5897
Interbank loans (% of assets)	-14.13268	11.01565	-1.282963	0.2044
Equity (% of liquid assets)	-0.004823	0.013545	-0.356049	0.7231
Growth rate of real GDP	0.209031	0.199804	1.046179	0.2997
M2 (% of M2)	0.402205	0.236085	1.703640	0.0936
Inflation	0.094282	0.087111	1.082320	0.2834
Domestic credits provided by banks (% of GDP)	0.022249	0.049270	0.451571	0.6532
Domestic credits to private sector (% of GDP)	-0.115642	0.075262	-1.536523	0.1297
Real interest rate	0.332117	0.136122	2.439855	0.0177
Change in real effective exchange rate	0.113014	0.049648	2.276291	0.0264
GDP per capita	-0.006843	0.002774	-2.466667	0.0165
Fixed Effects				
Benin	5.763126			
Botswana	23.23406			
Cameroon	1.129632			
Cape Verde	-5.674650			
Chad	0.641106			
Cote d'Ivoire	4.946428			
Ethiopia	-12.76202			
Kenya	-10.09244			
Malawi	-6.678827			
Mali	9.510565			
Rwanda	-0.605327			
Senegal	0.857862			
South Africa	16.48763			
Swaziland	13.09130			
Togo	1.240846			
Zimbabwe	0.950919			
R-squared	0.609264	Mean dependent var		4.589589
Adjusted R-squared	0.420408	S.D. dependent var		4.780274
S.E. of regression	3.639268	Sum squared resid		794.6562

F-statistic	3.226080	Durbin-Watson stat	1.922517
Prob(F-statistic)	0.000063		

The variable GDP per capita has a negative sign; a prolonged economic recession and downturns coupled with falling per capita GDP is likely to increase the scope of default on loans, especially in the most depressed sectors of the economies. In the most extreme cases, runs on banks during falling GDP per capita are also accompanied by a rapid decline in per capita income in real terms [World Bank (1998)].[40] In this particular case, domestic savings may be one of the possible transmission channels from economic downturn to banking crisis. In particular, the most affected countries witnessed a dramatic fall in their saving rates over the crisis period. For instance, domestic saving which averaged over 25 per cent of GDP between 1980 and 1985, fell to about 18 percent between 1996 and 2003 in Cameroon. A similar pattern was observed in Kenya, where average saving rates fell from over 16 percent of GDP to a little over 8 percent over the same period [World Bank (2004)].[41]

The sign associated with GDP per capita is consistent for the full panel and the sub-panel of non-CFA countries. In spite of the smaller probability value associated with these two panels, it is worth pointing out that the estimated coefficient associated with this determinant is extremely low, however, reflecting a possible dual causality between per capita GDP growth and impaired loans. Falling per capita GDP and hence, income may erode domestic savings and ultimately lead to a banking crisis in a recessionary context. Conversely, a prolonged banking crisis may ultimately lead to economic downturns, possibly through the saving-investment channels.

Among the remaining significant macro variables, real interest rate, broad money supply (M2) and changes in real effective exchange rate have positive signs for the full sample, suggesting a positive covariance structure with nonperforming loans. More specifically, a real exchange rate appreciation may have weakened the performance of export-oriented sectors of the economy, and exacerbated the banking crisis, especially for economies which are highly dependent on exports. This was the case for a number of countries in the CFA sub-panel. These countries witnessed a rapid appreciation of their currency in the 80s and early 90s. When coupled with a deterioration of terms of trade, some of these countries, especially Cameroon and Côte d'Ivoire, the leading coffee and cocoa exporters, were dramatically affected by the banking crisis in the 90s, partly as a result of large concentration of loans in the depressed agricultural export sectors [Daumont et al. (2004)]. The much smaller probability value associated with changes in real effective exchange rate for countries in the CFA sub-panel may indeed reflect the relatively strong correlation with nonperforming loans and real exchange rates appreciation.

However, for a number of macroeconomic regressors, the probability value is unexpectedly high for the full panel and across sub-panels of CFA and non-CFA countries. This is especially the case for inflation and domestic credits provided by banks. For the latter regressor, the probability largely exceeds the 10 per cent threshold level. Although much lower for inflation, it is still relatively high, suggesting that inflationary pressures may not have played a critical role in the rapid accumulation of impaired loans in the 1990s. Indeed,

[40] In Cameroon for instance, per capita income fell by over 50 percent in real terms [Emini and Fofack (2004)].

[41] Invariably, banking crises are associated with falling saving rates across Sub-Saharan Africa. Negative trends are also observed in Ethiopia, Zimbabwe and Côte d'Ivoire. In the latter, average saving rates fell from over 21 per cent of GDP in the early 80s to less than 16 per cent in the early 90s.

even the sub-panel of CFA countries, which witnessed a rapid acceleration of price increase in the aftermath of the CFA Franc devaluation has a relatively large probability value, suggesting that inflationary pressures may have played a stronger role in the sub-panel of non-CFA countries.[42] The Sub-Saharan Africa banking crisis of the 90s was not inflationary-prone. An inflationary-prone banking crisis would have come with an expansion monetary policy, including through a rapid increase of domestic credits. Conversely, the non significance of domestic credits could be a reflection of erosion of banks assets and resources, which may have lowered the supply and demand curves of money.

For countries in the CFA sub-panel, the most significant variables include broad money supply (M2) and change in real effective exchange rate, which have positive signs, again suggesting a positive covariance structure with nonperforming loans. An increase in the aggregate stock of money and/or real exchange rate appreciation may have contributed to a deterioration of banks portfolios in these countries. For most of these countries, the banking crisis was coupled with exchange rate crisis, producing a classical Twin Crises.[43] A possible transmission channel in this context could run from balance of payments problems to banking crisis, possibly through problems loans accumulated from exports promotion to a depressed agricultural sector confronted with falling exports as a result of exchange rate appreciation coupled with terms of trade deterioration.[44] Also critical are expectations formulated by economic agents in the face of sustained balance of payments crises and overvalued exchange rate. In anticipation of exchange rate devaluation, runs on banks could be exacerbated by increased capital flights and massive outflow of funds [Miller (1995)].

However, the significance of real exchange rate is not as strong for the sub-panel of non-CFA countries, probably reflecting the automatic adjustment process under flexible exchange rates regimes. Real interest rate is the most significant macro regressor in this sub-panel. This variable is significant at the 10 per cent level, and its estimated coefficient has a positive sign. The persistence of high and prohibitive real interest rates can transform a fragile banking system into a financial crisis, especially through the accumulation of defaults on loan payments and the moral hazard channels. The positive covariance structure between real interest rates and nonperforming loans in this sub-panel may reflect the more deregulated nature of the banking industry that was initiated in the 80s and resulted in a rapid increase in interest rates [Brownbridge (1998)].[45] Moreover, in a context of high inefficiency, where formal banks are less competitive than informal financial institution, runs on banks can be exacerbated by interest rates differentials between banks deposits and interest rates on informal financial markets.[46]

In order to further assess the linkages between macroeconomic performance and nonperforming loans, the pseudo-panel model is applied to the data to predict nonperforming loans in the post-2002 period, using actual data. The prediction considers two alternative scenarios. The first and high case scenario assumes improved macroeconomic framework.

[42] Indeed, inflation contributed to a rapid erosion of banks equity and increased credit risks in Kenya, Nigeria and Zambia [Brownbridge (1998)].
[43] For further details, see Goldfajn and Valdes (1995) and Miller (1995).
[44] For further details on balance of payments problems to banking and financial crisis, see Stoker (1994).
[45] In general, most banking and financial crises have occurred in context of deregulation characterized by abnormally high real interest rates. It has been shown that annualized real interest rates are about 13 percentage points higher than average observed during normal time on the eve and throughout the crisis [Kaminsky and Reinhart (1996)].
[46] Indeed, low interest rates on bank deposit relative to interest rates on informal financial markets may reduce the supply of funds through the banking system and promote disintermediation [Agénor (2000)].

Under this scenario, all variables are taken to be constant except GDP per capita, which is assumed to be growing at a rate 5 percent higher than the average over the reference period, inflation, which is 5 percent lower than its average between 1993 and 2002, over the prediction range. Similarly real interest rate is taken to be 5 percent lower than its average over the prediction range. Conversely, the second and low case scenario assumes lower per capita GDP, which is taken to be 5 percent lower over the prediction range, while inflation is taken to be 5 percent higher than its average.

The results, in Figure 3, focus on Benin, Ethiopia and Senegal. The prediction of nonperforming loans derived from the models and expressed in percentage of loan loss provision highlight the contrast between the high case (left panel) and low case (right panel). A negative slope in the trend of nonperforming loans in the left panel is mirrored by a positive slope in the right panel, suggesting increased scope of nonperforming loans and a deterioration of banks portfolios under increased macroeconomic volatility and economic downturns. The results are consistent across countries and over the prediction range 2002-2010. In Benin, for instance, nonperforming loans fell from over 7% to less than 3% of loans loss provision over the prediction range in the high case scenario; they increased to over 10% in the worse case scenario.

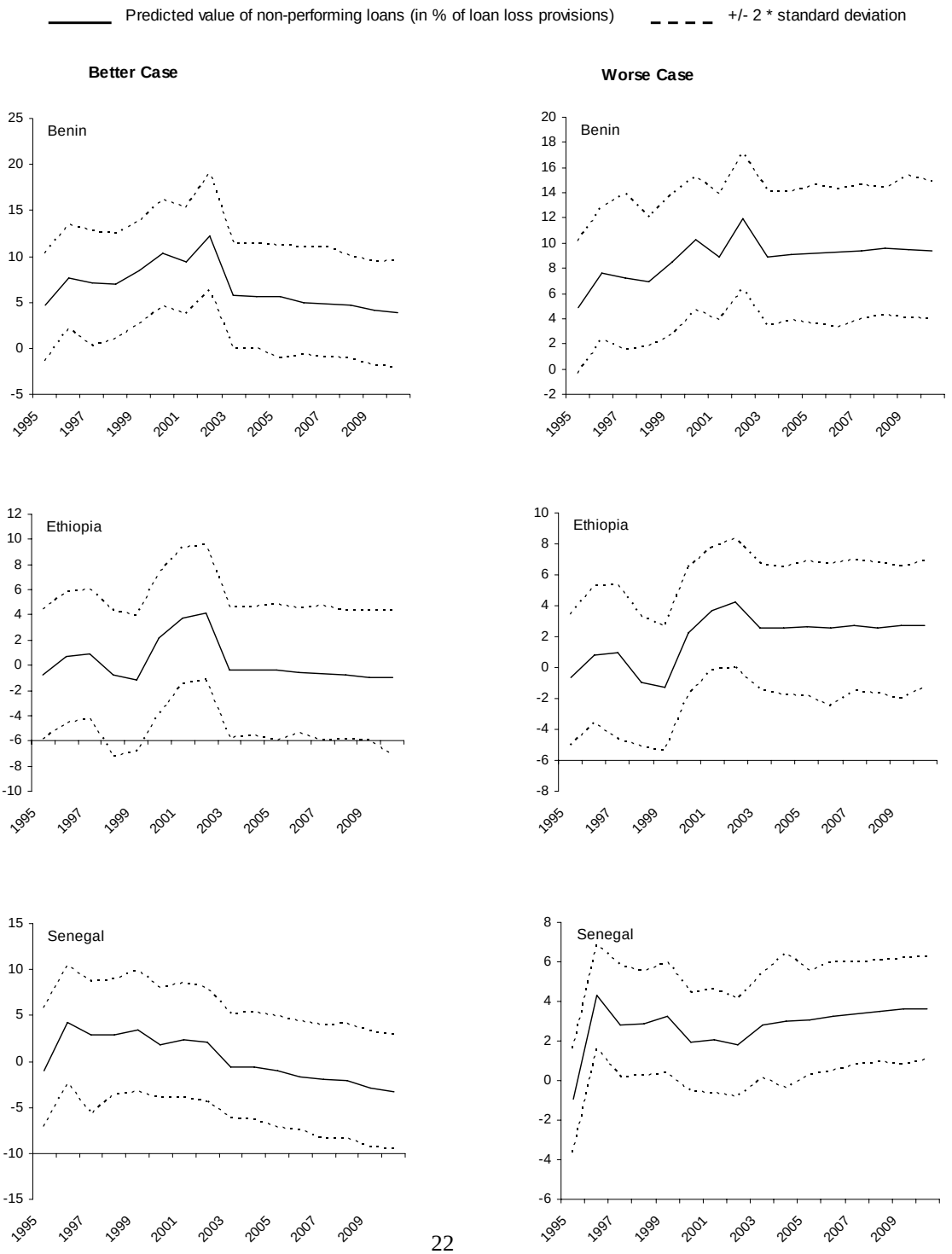
The preeminence of macroeconomic volatility is also illustrated by the scope of macro determinants. For the full panel, the most significant microeconomic predictor is “net interest margins”— a measure of banks profitability. With a probability value falling below 0.005, this predictor is significant at the one percent level. Its estimated coefficient has a negative sign. This is consistent with the correlation analysis and suggests that a decrease in profits, possibly via falling interest margins could affect banks portfolios, through a reduction in asset. However, this variable is not significant in the full panel. Moreover, none of the selected measure of capital adequacy and profitability is significant for the sub-panel of CFA countries. The relatively low number of significant banking-level variables in this sub-panel further corroborates and reinforces the preeminence of macroeconomic volatility in explaining the accumulation of nonperforming loans in these countries.

For the sub-panel of non-CFA countries, the most significant banking-level variables include equity-to-total assets and interbank loans. The probability value associated with these predictors is less than 10 percent. The coefficient associated with interbank loans has a positive sign, suggesting a positive covariance structure with nonperforming loans. Interbank loans are generally executed at extremely high and prohibitive rates, and the build-up of these loans to meet short-term liquidity needs by banks may have contributed to a rapid increase of impaired loans, indirectly through high-priced loans, compounded with moral hazard. The recourse to a highly prohibitive short-term liquidity in the form of interbank loans may also be a reflection of erosion of banks asset and a relatively low level of equity in problems banks. The increase in the level of minimum capital requirements initiated recently across Sub-Saharan Africa aims among others at raising banks equity and mitigating short-term liquidity crises, and hence reducing the prospects of moral hazard.

Although, raising the level of banks equity may reduce the prospects for short-term liquidity crisis, the risk exposure may remain significant, especially in an environment of high concentration, where the distribution of loans is heavily skewed towards few sectors and economic agents [Brownbridge (1998)]. In this context, economic downturns could still affect banks, including the ones which raised their capital base. In the absence of deposit

insurance guarantee mechanisms to secure the funds and deposits made by creditors, the mobilization of short-term liquidity via interbanks loans could still have a negative effect on banks portfolios, leading to runs on banks and financial institutions.

Figure 3: Predicted Value of Nonperforming Loans in Percent of Loan Loss Provision following changes in macroeconomic determinants



In order to further illustrate the linkages between microeconomic factors and nonperforming loans and the potential impact of the first set of variables on the latter, the pseudo-panel model is applied to the data to derive predicted values of nonperforming loans in the post-2002 period. Similarly, the predictions consider two alternative scenarios. The high case scenario assumes higher net interest margins and equity over the prediction range where variables are taken to be 5 percent higher than their average value between 1993 and 2002. Conversely, the second and low case scenario assumes lower net interest margins and equity in percent of liquid assets over the prediction range where they are assumed to take values that are about 5 percent lower than the average.

The results, in Figure 4, focus on three countries: Benin, Ethiopia and Togo. The predicted values of nonperforming loans derived from the models and expressed in percentage of loan loss provision highlight the contrast between the high case (left panel) and low case scenario (right panel). Under the high case scenario, the level of nonperforming loans drops sharply in the post-2002, and remains virtually constant over the prediction range, at about 5 percent of loan loss provision in Benin, and significantly lower in Ethiopia and Togo. That predicted value is about 1 percent of loan loss provision in Togo and significantly less in Ethiopia. The alternative low case scenario highlights a sharp contrast, with a dramatic increase of impaired loans over the prediction range across all countries. For instance, the predicted value account for over 10 percent of loans loss provision in Ethiopia and is relatively high in Benin and Togo as well.

Figure 5 shows the predicted values of these loans over the prediction range and under concurrent changes of macro and microeconomic variables by way of assessing the joint effect of macroeconomic volatility and changes in banks portfolios on nonperforming loans. Similarly, the prediction models consider the high and low case scenarios. While GDP per capita, net interest margins and equity are expected to be growing at a rate 5 percent higher than the average over the reference period, interest rate and inflation are assumed to be 5 percent lower. In the low-case scenario, GDP per capita, net interest margins and equity are expected to be declining at a rate 5 percent lower than the average over the reference period, and inflation and interest rates are expected to be much higher, about 5 percent higher than average over the prediction range.

Figure 5 shows the predicted values of nonperforming loans under a simultaneous change of macro and microeconomic variables for the following countries: Benin, Botswana, and Ethiopia. Once again, the graphs highlight the contrast between the high case (left panel) and low case (right panel). In the high-case scenario of sustained economic growth and macroeconomic stability and high interest margins, nonperforming loans are confined to less than 2 percent of loan loss provisions in Benin. On the contrary, a dramatic increase in these loans is recorded in the low-case scenario (worse case), where the predicted value rises to exceed 12 percent of loan loss provision over the prediction range. A similar contrast between the high and low-case scenario is observed in Botswana and Ethiopia. The reduction in the scope of nonperforming loans in the high-case is mirrored by a rapid increase in the

low-case scenario, with impaired loans exceeding 5 and 8 percent of loan loss provision in 2010 in Ethiopia and Botswana, respectively.

Figure 4: Predicted Value of Nonperforming Loans in Percent of Loan Loss Provision following changes in Banking-level Determinant

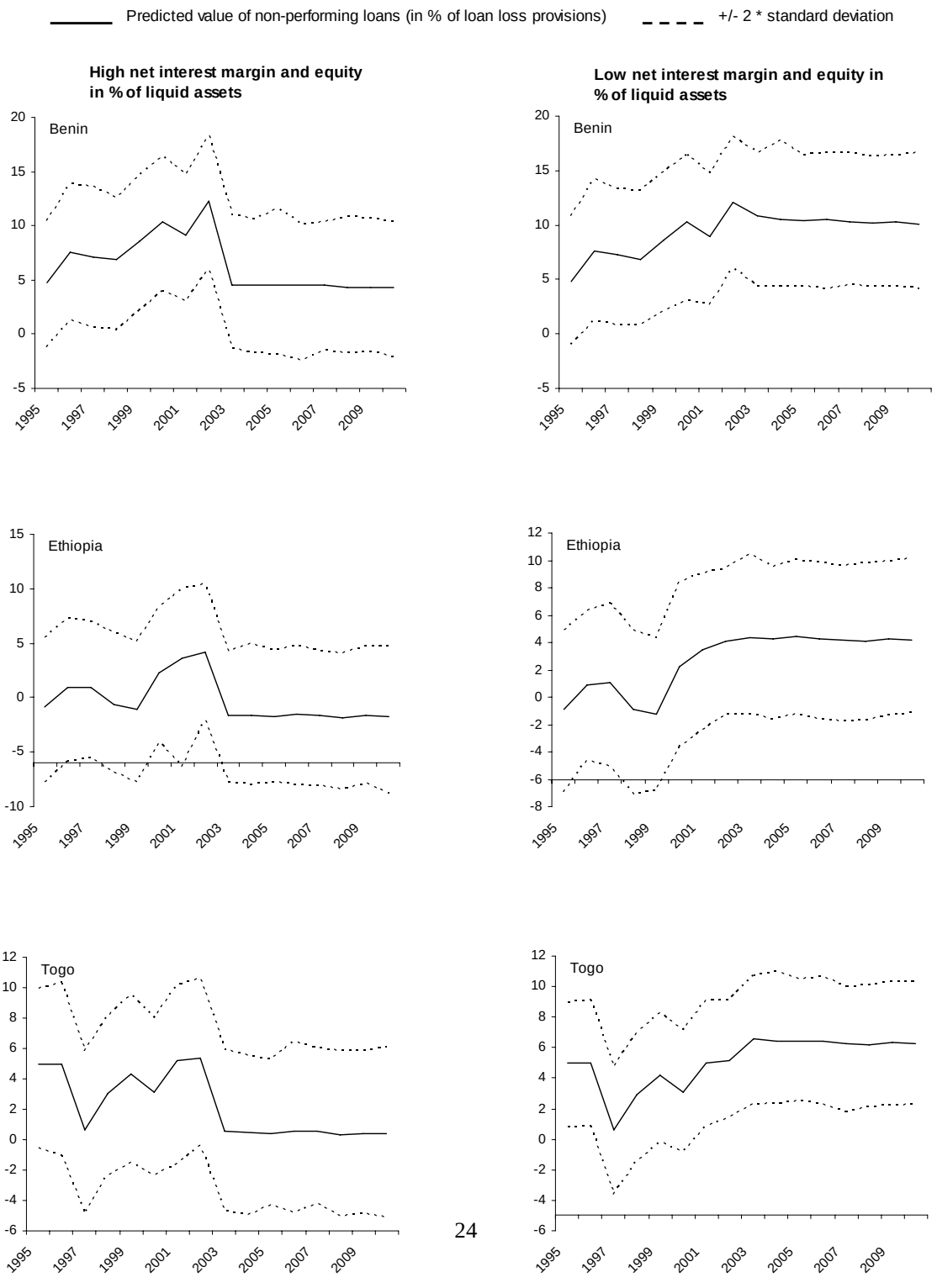
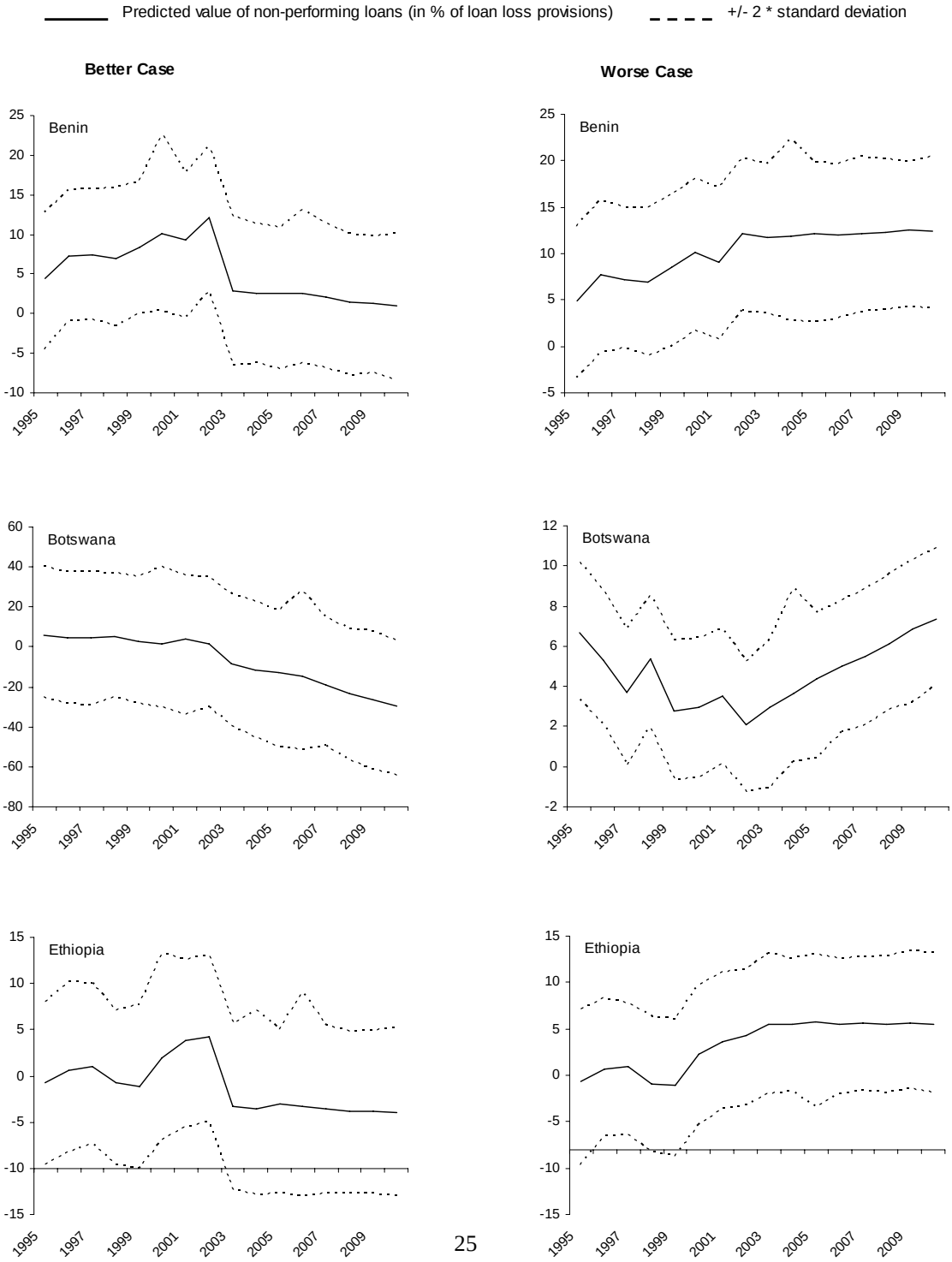


Figure 5: Predicted Value of Nonperforming Loans in Percent of Loan Loss Provision following joint-changes in Macro and Banking-level determinants



VI. Concluding Remarks

This paper explores the leading causes of nonperforming loans in Sub-Saharan Africa in the 1990s, using causality and pseudo-panel models. The results show a dramatic increase in nonperforming loans and heightened credit risks, with considerable gaps between the sub-panels of CFA and non-CFA countries. These risks reflect the rapid accumulation of impaired loans, and are largely driven by macroeconomic volatility and terms of trade deterioration. They are particularly high in the agricultural sector and illustrate the extremely high vulnerability of African economies which, in the absence of diversification, remain heavily exposed to macroeconomic and exogenous shocks.

In addition to terms of trade deterioration, there are other leading causes of banking crises in Sub-Saharan Africa. A Granger-Causality analysis identifies inflation, real interest rate, growth rate of GDP per capita, net interest margins, return on assets, interbank loans as other possible determinants. The Granger-Causality results are further corroborated with a pseudo-panel analysis which highlights the preeminence of macroeconomic volatility in explaining the proportional variance of these loans. Real exchange rate, interest rates and growth rate of GDP per capita are particularly robust and significant. Credit risks tend to be particularly high during episodes of sustained economic downturns. Interesting enough, inflation does not appear to be particularly significant in explaining the dynamics on nonperforming loans, especially in the sub-panel of CFA countries, in spite of post-devaluation inflationary pressures of the mid-1990s. Inflationary effects are stronger in the sub-panel of non-CFA countries, however. Indeed, in some of these countries, the allocation of a large amount of credit to distressed banks by the Central Bank was a source of monetary expansion and fueled inflationary pressure, which was partly responsible for the erosion of bank capital.

The cost of nonperforming loans is significant for taxpayers and depositors in numerous countries, and especially in the ones which were confronted with balance of payments crises and fiscal deficits. The rise of nonperforming loans led to a deterioration of bank assets and erosion of their capital. In the short run, numerous banks facing liquidity problems resorted to short-term financing in the form of interbank loans. However, the high cost of these loans further exacerbated the banking crisis. In a number of countries, it shifted bank lending incentives toward imprudently high-risk alternatives, and hence increased runs on banks and direct losses to depositors in the absence of a deposit insurance scheme.

While the intermediation functions played by well-managed banks can be a source of investment and economic growth, the deterioration of banks and financial systems illustrated notably by the rise of credit risks and bank failures has tremendous economic and welfare implications for governments and households alike. At the governmental level, it poses serious challenges to the pursuit of macroeconomic stability and growth objectives, especially in the context of a narrow tax base and growing fiscal deficits. The reduction of disposable income following direct losses to depositors in the absence of insurance guarantee mechanisms can contribute to a rapid deterioration of welfare, especially when per capita income is already low and poverty is widespread. Future research will investigate the welfare implications of banking and financial crises in Sub-Saharan Africa, and the direction of causality between balance of payments and banking crises, especially in the sub-panel of CFA countries, which suffered balance of payments and banking crises in the 1990s.

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ANNEXES

Table 1: Ranking of Countries by Equity to Liquid Assets Ratio

Countries	Equity/Liquid Assets (in percent)	Rank Ordering	Assessment
Benin	20.51	2	Low
Botswana	659.40	13	High
Cape Verde	22.02	3	Low
Cameroon	28.94	4	Low
Chad	42.34	9	Medium
Côte d'Ivoire	61719.75	16	High
Ethiopia	38.27	6	Medium
Kenya	43.92	10	Medium
Malawi	41.65	8	Medium
Mali	23419.32	15	High
Rwanda	39.88	7	Medium
Senegal	46.06	11	Medium
South Africa	59.64	12	High
Swaziland	13.89	1	Low
Togo	1398.01	14	High
Zimbabwe	30.45	5	Low

Table 2: Banks Portfolios and Assets by Ownership Structure in Sub-Saharan Africa (Averages over 1993-2002)

	Publicly-owned Banks				Privately-owned Banks			
Countries	**NPL/ LLR**	**NPL/ LLP**	**NPL/ TA**	**Capital Asset ratio**	**NPL/ LLR**	**NPL/ LLP**	**NPL/ TA**	**Capital Asset ratio**
Benin	1.00	..	0.011	0.124	1.737	7.127	0.059	0.062
Botswana	..	..	..	0.460	1.157	3.653	0.025	0.112
Cameroon	..	..	..	..	..	1.603	0.026	0.063
Cape Verde	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..
Côte d'Ivoire	..	..	..	..	1.894	3.333	0.043	0.090
Ethiopia	1.362	..	0.136	0.067	1.076	1.917	0.019	0.126
Kenya	1.539	6.20	0.170	0.163	2.984	6.579	0.115	0.147
Malawi	..	..	..	0.211	2.167	0.833	0.031	0.133
Mali	1.196	10.071	0.110	0.116	1.889	15.289	0.073	0.084
Rwanda	1.600	1.500	0.166	0.203	2.00	..	0.069	0.063
Senegal	..	1.033	0.109	0.091	2.585	2.713	0.045	0.083
South Africa	0.695	9.485	0.032	0.550	1.395	4.988	0.044	0.323
Swaziland	..	..	..	0.185	1.891	5.500	0.075	0.006
Togo	1.750	2.25	0.079	0.275	1.486	4.260	0.045	0.067
Zimbabwe	1.00	..	0.318	0.454	1.057	3.387	0.044	0.176
All CFA	**1.315**	**4.452**	**0.062**	**0.152**	**1.918**	**5.720**	**0.041**	**0.075**
All Non-CFA	**1.239**	**0.595**	**0.164**	**0.286**	**1.716**	**3.599**	**0.0530**	**0.136**
All SSA	**1.268**	**1.928**	**0.113**	**0.241**	**1.794**	**4.578**	**0.047**	**0.110**

Table 3: Correlation Analysis between Nonperforming Loans and Selected Banking and Macroeconomic Variables in the Sub-Panel of CFA Countries

Variables	All Banks	State Banks	Private Banks
MACROECONOMIC VARIABLES			
Real GDP growth rate	0.27	-0.74	0.17
Real GDP per capita	0.03	-0.52	-0.14
M2 in % of GDP	0.35	0.73	0.14
CPI inflation rate	-0.09	0.05	-0.10
GDP deflator inflation rate	0.09	0.03	-.030
Domestic credit provided by banks (in % of GDP)	0.12	0.72	-0.34
Real interest rate	-0.78	..	..
Interest rate spread	-0.39	..	..
Real GDP growth rate 2	0.29	-0.74	0.21
Real GDP per capita 2	-0.01	-0.52	-0.15
CPI inflation rate 2	-0.09	0.05	-0.10
BANKING VARIABLES			
Equity (in % of total asset)	0.22	-0.60	0.36
Return on asset	-0.07	-0.62	-0.38
Total deposit (in % of total assets)	-0.18	-0.66	-0.05
Total deposit (in % of total liabilities)	0.32	0.33	-0.36
Return on equity	-0.43	-0.83	-0.22
Net interest margin	-0.24	-0.89	0.20
Net income (in % of total revenue)	-0.03	-0.61	-0.38

Table 4: Correlation Analysis between Nonperforming Loans and Selected Banking and Macroeconomic Variables in the Sub-Panel of non-CFA Countries

Variables	All Banks	State Banks	Private Banks
MACROECONOMIC VARIABLES			
Real GDP growth rate	0.13	-0.18	-0.04
Real GDP per capita	-0.44	-0.80	-0.40
M2 in % of GDP	-0.36	-0.19	-0.11
CPI inflation rate	-0.16	0.46	-0.22
GDP deflator inflation rate	-0.07	0.51	-0.27
Domestic credit provided by banks (in % of GDP)	0.11	0.34	0.00
Real interest rate	0.05	0.00	-0.02
Interest rate spread	-0.14	0.29	-0.02
Real GDP growth rate 2	0.20	-0.18	0.05
Real GDP per capita 2	-0.40	-0.76	-0.37
CPI inflation rate 2	-0.16	0.46	-0.22
BANKING VARIABLES			
Equity (in % of total asset)	-0.20	-0.54	0.09
Return on asset	-0.20	-0.67	-0.21
Total deposit (in % of total assets)	-0.07	0.15	0.31
Total deposit (in % of total liabilities)	-0.26	-0.08	-0.07
Return on equity	-0.17	-0.68	-0.14
Net interest margin	-0.28	-0.49	-0.17
Net income (in % of total revenue)	-0.19	-0.49	-0.23

Table 5a: Granger Causality Test Results (Macro variables)

H_0: X does not Granger Cause Y. H_0 is rejected for the following X and Y variables.			
X	**Y**	**F-test**	**No of lags**
BENIN			
Inflation	NPL_LLP	4.649 (*)	1
Real Interest rate	NPL_LLP	4.649 (*)	1
BOSTWANA			
Growth rate of GDP per capita	NPL_LLP **(dual)**	6.129 (*)	1
NPL_LLP	Real interest rate	5.911 (*)	1
	Growth rate of GDP per capita **(dual)**	5.808 (*)	1
CAMEROON			
Inflation	NPL_LLP	19.775 (***)	1
Nominal interest rate	NPL_LLP	18.093 (*)	2
	NPL_LLP **(dual)**	4.131 (*)	1
Real interest rate	NPL_LLP	19.047 (***)	1
Growth rate of GDP per capita	NPL_LLP	37.872 (***)	1
Growth rate of real GDP	NPL_LLP	37.774 (***)	1
GDP per capita	NPL_LLP	5.302 (*)	1
NPL_LLP	Nominal interest rate **(dual)**	6.145 (*)	1
COTE D'IVOIRE			
NPL_LLP	Growth rate of real GDP	812.198 (**)	1
ETHIOPIA			
Growth rate of GDP per capita	NPL_LLP	76.314 (*)	1
Growth rate of real GDP	NPL_LLP	79.211 (*)	1
KENYA			
Inflation	NPL_LLP **(dual)**	17.327 (**)	1
NPL_LLP	Inflation **(dual)**	9.012 (*)	1
MALI			
GDP per capita	NPL_LLP **(dual)**	17326.9 (***)	2
NPL_LLP	Inflation	30.831 (***)	1
	Real interest rate	30.831 (***)	1
	Growth rate of GDP per capita	52.177 (*)	2
	Growth rate of real GDP	61.704 (*)	2
	GDP per capita **(dual)**	50.451 (*)	2
SENEGAL			
Inflation	NPL_LLP	28.289 (**)	2
Real interest rate	NPL_LLP	28.289 (**)	2
GDP per capita	NPL_LLP	11.170 (**)	2
SOUTH AFRICA			
Nominal interest rate	NPL_LLP **(dual)**	6.923 (*)	2
NPL_LLP	Inflation	8.366 (**)	1
	Nominal interest rate **(dual)**	16.912 (**)	2

	Nominal interest rate	29.641 (***)	1
SWAZILAND			
GDP per capita	NPL_LLP	108.120 (*)	1
TOGO			
Growth rate of GDP per capita	NPL_LLP	1336.42 (**)	2
	NPL_LLP	7.738 (**)	1
Growth rate of real GDP	NPL_LLP	1076.15 (**)	2
	NPL_LLP	8.456 (**)	1
ZIMBABWE			
NPL_LLP	Growth rate of GDP per capita	6660.01 (***)	2
	Growth rate of real GDP	2621.07 (**)	2
	Growth rate of real GDP	4.629 (*)	1
	GDP per capita	4.555 (*)	1

Note: (***), (**), and (*) stands for 1%, 5%, and 10% significance level. NPL_LLP = Non-performing loans in percent of loan loss provisions.

Table 5b: Granger Causality Test Results (Micro Variables including Moral Hazard Variables)

H_0: X does not Granger Cause Y. H_0 is rejected for the following X and Y variables.			
X	**Y**	**F-test**	**No of lags**
BENIN			
NPL_LLP	Net income in % of total revenue	7.342 (**)	1
	Equity/liquid assets	47.774 (***)	1
Net interest margin	NPL_LLP	291.618 (***)	2
BOSTWANA			
Net interest margin	NPL_LLP	10.589 (**)	1
CAMEROON			
NPL_LLP	Net income in % of total revenue	178.032 (**)	1
Interbank loans/total assets	NPL_LLP	3365.5 (**)	2
COTE D'IVOIRE			
Interbank loans/total loans	NPL_LLP	53.183 (*)	1
Interbank loans/total assets	NPL_LLP	86.279 (*)	1
ETHIOPIA			
NPL_LLP	Equity/liquid assets	60.487 (*)	1
KENYA			
NPL_LLP	Interbank loans/total loans	43.445 (***)	1
	Interbank loans/total assets	12.311 (**)	1
	Equity/liquid assets	7.930 (*)	1
MALI			
Net income in % of total revenue	NPL_LLP	26.305 (***)	1
Return on Assets	NPL_LLP	25.286 (***)	1
Net interest margin	NPL_LLP	62.474 (*)	2
Return on Assets	NPL_LLP	713.917 (**)	2
Interbank loans/total loans	NPL_LLP	5.747 (*)	1
Interbank loans/total assets	NPL_LLP	6.658 (*)	1
SENEGAL			
NPL_LLP	Net income in % of total revenue	20.982 (**)	1
Net interest margin	NPL_LLP	7.197 (**)	1
Return on Assets	NPL_LLP	14.081 (**)	2
Equity/liquid assets	NPL_LLP	51.677 (***)	1
SOUTH AFRICA			
Net income in % of total revenue	NPL_LLP **(dual)**	12.218 (**)	1
NPL_LLP	Net income in % of total revenue	19.129 (**)	2
	Interbank loans/total assets	184893 (***)	2

	Equity/liquid assets	141.161 (*)	2
	Equity/liquid assets	8.926 (**)	1
SWAZILAND			
NPL_LLP	Net interest margin	31651.0 (***)	1
TOGO			
NPL_LLP	Equity/liquid assets	1076.96 (**)	2
ZIMBABWE			
NPL_LLP	Net interest margin	212.666 (**)	2
Equity/liquid assets	NPL_LLP	24.875 (***)	1

Note: (***), (**), and (*) stands for 1%, 5%, and 10% significance level. NPL_LLP = Non-performing loans in percent of loan loss provisions.

Table 6: Determinants of Non-performing Loans in the Sub-Panel of CFA Countries (Panel Results)

Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Equity (% of total assets)	23.95248	27.89792	0.858576	0.3987
Return on asset	13.93475	172.1980	0.080923	0.9361
Net interest margin	-104.1752	84.34819	-1.235062	0.2283
Net income (% of total revenue)	1.995583	5.833536	0.342088	0.7351
Interbank loans (% of assets)	-34.21973	26.26303	-1.302962	0.2045
Equity (% of liquid assets)	-0.002063	0.014250	-0.144753	0.8861
Growth rate of real GDP	0.221568	0.338738	0.654099	0.5190
M2 (% of M2)	0.871587	0.499844	1.743720	0.0935
Inflation	-2.821116	4.726933	-0.596817	0.5560
Domestic credits provided by banks (% of GDP)	0.025069	0.554686	0.045196	0.9643
Domestic credits to private sector (% of GDP)	-0.213638	0.847545	-0.252067	0.8031
Real interest rate	-2.280659	4.652920	-0.490157	0.6283
Change in real effective exchange rate	0.281746	0.181876	1.549114	0.1339
GDP per capita	0.004887	0.036531	0.133766	0.8947
Fixed Effects				
Benin	12.65234			
Cameroon	11.79177			
Chad	19.27803			
Cote d'Ivoire	5.727139			
Mali	17.48693			
Senegal	4.977646			
Togo	9.240806			
R-squared	0.730415	Mean dependent var		5.230247
Adjusted R-squared	0.514748	S.D. dependent var		5.725748
S.E. of regression	3.988560	Sum squared resid		397.7153
Log likelihood	-114.8844	F-statistic		3.386762
Durbin-Watson stat	1.980894	Prob(F-statistic)		0.002269

Table 7: Determinants of Non-performing Loans in the Sub-Panel of Non-CFA Countries (Panel Results)

Variables	Coefficient	Std. Error	t-Statistic	Prob.
Equity (% of total assets)	45.79182	23.23582	1.970743	0.0621
Return on asset	-58.74186	49.59291	-1.184481	0.2495
Net interest margin	-37.18988	22.67576	-1.640072	0.1159
Net income (% of total revenue)	-2.602749	4.737830	-0.549355	0.5886
Interbank loans (% of assets)	29.39404	15.66541	1.876366	0.0746
Equity (% of liquid assets)	-0.292836	0.217901	-1.343895	0.1933
Growth rate of real GDP	-0.342472	0.238467	-1.436137	0.1657
M2 (% of M2)	-0.126559	0.154536	-0.818961	0.4220
Inflation	-0.090213	0.091323	-0.987852	0.3345
Domestic credits provided by banks (% of GDP)	0.036992	0.048446	0.763563	0.4536
Domestic credits to private sector (% of GDP)	-0.141431	0.083080	-1.702348	0.1034
Real interest rate	0.238271	0.129710	1.836942	0.0804
Change in real effective exchange rate	0.064114	0.045564	1.407102	0.1740
GDP per capita	-0.003254	0.002259	-1.440636	0.1644
Fixed Effects				
Botswana	23.59307			
Cape Verde	10.79121			
Ethiopia	-0.531578			
Kenya	7.497972			
Malawi	-12.16939			
Rwanda	0.146271			
South Africa	19.60049			
Swaziland	8.748962			
Zimbabwe	6.672059			
R-squared	0.699200	Mean dependent var		3.919811
Adjusted R-squared	0.384077	S.D. dependent var		3.476945
S.E. of regression	2.728733	Sum squared resid		156.3657
F-statistic	2.218815	Durbin-Watson stat		2.571677
Prob(F-statistic)	0.036398			